APPENDIX F
Preliminary Geotechnical and Infiltration Evaluation

PRELIMINARY GEOTECHNICAL AND INFILTRATION EVALUATION
PROPOSED WAREHOUSE DEVELOPMENT
24 MALBERT STREET
APN 330-040-062
PERRIS, RIVERSIDE COUNTY, CALIFORNIA

PREPARED FOR

KSP STUDIO
23 ORCHARD ROAD
LAKE FOREST, CALIFORNIA 92630

ATTENTION: MR. SHAB VAKILI

PREPARED BY

GEOTEK, INC.
1548 NORTH MAPLE STREET
CORONA, CALIFORNIA 92880

PROJECT NO. 2156-CR **JULY 29, 2019**

GEOTEK

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July 29, 2019
Project No. 2156-CR

KSP Studio
23 Orchard Road
Lake Forest, California 92630

Attention: Mr. Shab Vakili

Subject: Preliminary Geotechnical and Infiltration Evaluation
Proposed Warehouse Development
24 Malbert Road
APN: 330-040-062
Perris, Riverside County, California

Dear Mr. Vakili:

We are pleased to provide the results of our preliminary geotechnical and infiltration evaluation for the proposed warehouse development that is planned to be constructed at 24 Malbert Road in the city of Perris, Riverside County, California. This report presents a discussion of our evaluation and provides preliminary geotechnical recommendations for site preparation, foundation design and construction. In addition, preliminary infiltration testing results and recommendations are presented for design of detention basins.

Based on the results of our evaluation, development of the property appears feasible from a geotechnical viewpoint provided that the recommendations presented in this report and in future reports are incorporated into design and construction.

The opportunity to be of service is sincerely appreciated. If you have any questions, please do not hesitate to contact our office.

Respectfully submitted,
GeoTek, Inc.

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ENCLOSURES

1. PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to evaluate the geotechnical conditions for the proposed warehouse development. Services provided for this study included the following:

- Research and review of available geologic and geotechnical data and general information pertinent to the site,
- A site reconnaissance,
- Excavation of five exploratory borings for the geotechnical portion of the evaluation,
- Infiltration testing within an additional three test borings in the vicinity of a planned storm water quality disposal area,
- Collection of soil samples from within the test borings,
- Laboratory testing of selected soil samples,
- Review and evaluation of site seismicity,
- Evaluation of liquefaction potential, and;
- Compilation of this geotechnical report which presents our preliminary recommendations for site development.

The intent of this report is to aid in the evaluation of the site for future proposed development from a geotechnical perspective. The professional opinions and geotechnical information contained in this report may need to be updated based upon our review of the final site development plans. These plans should be provided to GeoTek, Inc. (GeoTek) for review when available.

2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

2.1 SITE DESCRIPTION

The project site is a rectangular-shaped property located at 24 Malbert Road in the city of Perris, Riverside County, California. A Site Location Map is presented on Figure 1.

The site is located in an area characterized by industrial and commercials developments, which bound the property to the north, east and west; while Malbert Road and vacant land beyond border the property to the south.

The site is currently vacant land with no visual indications of structural improvements. There are some minor fill berms on the south portion of the property, scattered trash and volunteer vegetation throughout the site. The site elevations range from approximately 1442 feet above mean sea level in the north to 1439 feet above mean sea level in the south.

The site is located in an area surficially underlain by alluvium and undocumented fill. Granitic bedrock (quartz diorite) have also been observed and mapped at the property underlying the alluvium.

2.2 PROPOSED DEVELOPMENT

Based on the review of the *Preliminary Grading Plan*, prepared by David Li and Associates and with the latest revisions dated March 21, 2018, the proposed construction will consist of three warehouse buildings ranging from 3,000 square feet to 15,000 square feet. Associated parking/drive and landscaped areas are also planned for development. It is anticipated that the buildings will be one story in height, of reinforced concrete masonry unit (CMU) construction with conventional shallow foundations and concrete slabs on grade. In addition, underground detention chambers for storm water infiltration and storage are planned to underlie the paved driveway area within the southeastern portion of the site. As indicated on the plans provided, the detention chambers will likely have a depth of approximately seven feet to eight feet below the existing ground surface. Since topographic relief across the site is approximately three feet, minimal cuts and fills should be required to achieve the desired finished grades. Slopes and retaining walls are not anticipated for site development.

3. FIELD EXPLORATION AND LABORATORY TESTING

3.1 FIELD EXPLORATION

Our field exploration was conducted on June 26, 2019. For the geotechnical portion of the investigation, five exploratory borings were excavated with a truck mounted, hollow-stem auger drill rig to a maximum depth of 51.5 feet below ground surface. The boring locations are presented on the Exploration Location Map (Figure 3). A hollow-stem auger with an outside diameter of 7.9 inches was utilized. The inside diameter of the auger was 4.3 inches. The soils encountered were examined and visually classified by one of our geologists. A summary of the soil classifications is included in Appendix A.

The exploration logs show subsurface conditions at the dates and locations indicated and may not be representative of other locations and times. The stratification lines presented on the logs represent the approximate boundaries between soil types, and the transitions may be gradual.

In the geotechnical borings, relatively undisturbed soil samples were recovered at various intervals with a California sampler. The California sampler is a 2.9-inch outside diameter, 2.5-inch inside diameter, split barrel sampler lined with brass rings. The sampler was 18 inches long. The sampler conformed to the requirements of ASTM D 3550. A 140-pound automatic trip hammer was utilized, dropping 30 inches for each blow. The relatively undisturbed samples, together with bulk samples of representative soil types, were returned to the laboratory for testing and evaluation.

Standard penetration tests (SPT) were performed in Boring B-2 with a 2.0-inch outside diameter split-barrel sampler with a length of 18 inches. The inside diameter of the sampler shoe was 1.4 inches. The SPT sampler was unlined and conformed to the requirements of ASTM D 1586. The SPT sampler is machined to fit liners. A 140-pound automatic trip hammer was utilized, dropping 30 inches for each blow. An efficiency value of 1.0 was used for the automatic trip hammer. The standard penetration test data are presented on the boring logs in Appendix A.

For the infiltration portion of the study, three test borings were excavated to a depth of eight feet. Infiltration testing was conducted in these borings in accordance with the guidelines of the County of Riverside. The infiltration tests were prepared by drilling 8.0-inch diameter test holes to the desired depth and installing approximately two inches of gravel in the bottom of the holes. A 3.0-inch diameter perforated PVC pipe, wrapped in a filter sock, was placed in the excavations and the annular space was filled with gravel to prevent caving within the borings. Water was

then placed in the borings to presoak the holes and percolation testing was performed on the following day.

3.2 LABORATORY TESTING

Laboratory testing was performed on selected soil samples obtained during our field exploration. The purpose of the laboratory testing was to confirm the field classification of the soils encountered and to evaluate the physical properties of the soils for use in engineering design and analysis. Test results are presented in Appendix B.

4. GEOLOGIC AND SOILS CONDITIONS

4.1 REGIONAL SETTING

The subject property is situated in the Peninsular Ranges geomorphic province. The Peninsular Ranges province is one of the largest geomorphic units in western North America. It extends approximately 975 miles south of the Transverse Ranges geomorphic province to the tip of Baja California. This province varies in width from about 30 to 100 miles. It is bounded on the west by the Pacific Ocean, on the south by the Gulf of California and on the east by the Colorado Desert Province.

The Peninsular Ranges are essentially a series of northwest-southeast oriented fault blocks. Several major fault zones are found in this province. The Elsinore Fault zone and the San Jacinto Fault zone trend northwest-southeast and are found near the middle of the province. The San Andreas Fault zone borders the northeasterly margin of the province.

More specific to the subject property, the site is located in an area geologically mapped to be underlain by alluvium (Dibblee, T.W., and Minch, J.A., 2003). Granitic bedrock of quartz dioritic composition was observed underlying the alluvium in Boring B-2. A Geologic Map of the area is included in Figure 2.

The Elsinore Fault is located approximately 9 miles to the southwest of the site and the San Jacinto Fault is located approximately 10 miles to the northeast. A potential earthquake with a mean magnitude (MCE) of 6.9 may result from these faults. These are the known faults that would create the most significant earthshaking event. No faults are shown in the immediate site vicinity on maps reviewed for the area.

4.2 GENERAL SOIL/GEOLOGIC CONDITIONS

A brief description of the materials encountered on the site is presented in the following sections. Based on our field exploration and observations, the site is generally underlain by undocumented fill, alluvium and granitic bedrock.

4.2.1 Undocumented Fill

Fill was encountered in our exploratory Boring B-1. These materials were observed to consist of very dense silty sands that are various shades of brown and slightly moist with minor roots and rootlets.

4.2.2 Alluvium

Alluvium was encountered in all of our exploratory borings. These materials were observed to consist of medium dense to very dense sands, with varying amounts of silt and trace amounts of clay and gravel. The alluvium exhibited various shades of brown, orange and olive and was observed to be slightly moist to moist. Based on laboratory testing, the near surface alluvial soils exhibit a "very low" expansion potential.

4.2.3 Granitic Bedrock

Granitic bedrock of quartz diorite composition was encountered in our exploratory Boring B-2. These materials were encountered in the excavation below the older alluvium at a depth of approximately 39 feet below ground surface. The on-site bedrock encountered in subsurface exploration was recovered as very dense fine to coarse sand.

4.3 SURFACE AND GROUNDWATER

4.3.1 Surface Water

Overall site drainage is generally towards the south, as directed by site topography. Provisions for surface drainage will need to be accounted for by the project civil engineer.

4.3.2 Groundwater

Groundwater was encountered in exploratory Boring B-2 at a depth of 43 feet below ground surface. Based on groundwater levels reported in the vicinity of the site, the regional groundwater level ranges from 36 feet (reported in 2010) to 74 feet (reported in 2019) below ground surface (Geotracker, Water Data Library). Groundwater should not adversely affect the proposed warehouse developments.

4.4 INFILTRATION STUDY

Three infiltration test borings (I-1 to I-3 of Figure 3) were utilized for percolation testing. The borings were excavated to a depth of approximately eight feet below existing grade, to coincide with the planned elevation of the stormwater infiltration bottoms. Percolation testing was performed within the excavation by a representative from our firm on June 27, 2019 in general accordance with County of Riverside guidelines (Riverside County, 2011).

The percolation rates obtained in the test holes were converted to infiltration rates in accordance with the requirements of the referenced document (Porchet Method), and are presented in the following table:

SUMMARY OF INFILTRATION RATES		
Test Boring	**Depth of Test (feet)**	**Infiltration Rate (inches per hour)**
I-1	8.0	0.28
I-2	8.0	0.67
I-3	8.0	0.12

Over the lifetime of the storm water disposal area, the infiltration rates may be affected by silt build up and biological activities, as well as local variations in near surface soil conditions. According to the referenced document, a factor of safety used to compute the design infiltration rate shall not be less than 3.0 but may be higher at the discretion of the design engineer and acceptance of the plan reviewer. No factor of safety was applied to the above rates.

4.5 FAULTING AND SEISMICITY

The geologic structure of the entire southern California area is dominated mainly by northwest-trending faults associated with the San Andreas system. The site is in a seismically active region. No active or potentially active fault is presently known to exist at this site nor is the site situated within an *"Alquist-Priolo"* Earthquake Fault Zone (Bryant and Hart, 2007). The nearest mapped faults are the Elsinore Fault and San Jacinto Fault, located approximately 9 miles to the southwest and 10 miles to the northeast, respectively.

The site has not been mapped by the State of California for liquefaction potential. The County of Riverside indicates that this site is "not in a fault zone," "not within ½ mile of a fault," has a "low" liquefaction potential and is "susceptible" to subsidence. The City of Perris General Plan Safety Element indicates that the site is located in a zone having "moderate" liquefaction potential.

4.4.1 Seismic Design Parameters

The site is located at approximately 33.7675 Latitude and -117.2290 Longitude. Site spectral accelerations (Ss and S_1), for 0.2 and 1.0 second periods for a Class "D" site, were determined from the USGS Website, Earthquake Hazards Program, U.S. Seismic Design Maps, referencing the ASCE 7-10 Standard. The results are presented in the following table:

SITE SEISMIC PARAMETERS	
Mapped 0.2 sec Period Spectral Acceleration, S_s	1.5g
Mapped 1.0 sec Period Spectral Acceleration, S_1	0.6g
Site Coefficient for Site Class "D," F_a	1.0
Site Coefficient for Site Class "D" F_v	1.5
Maximum Considered Earthquake Spectral Response Acceleration for 0.2 Second, S_{MS}	1.5g
Maximum Considered Earthquake Spectral Response Acceleration for 1.0 Second, S_{M1}	0.9g
5% Damped Design Spectral Response Acceleration Parameter at 0.2 Second, S_{DS}	1.0g
5% Damped Design Spectral Response Acceleration Parameter at 1 second, S_{D1}	0.6g
Site-Modified Peak Ground Acceleration, PGA_M	0.5g

Final selection of the appropriate seismic design coefficients should be made by the project structural engineer based upon local practices and ordinances, expected building response and desired level of conservatism.

4.6 LIQUEFACTION

The County of Riverside indicates that the site has "low" liquefaction potential. The City of Perris indicates that the site has "moderate" liquefaction potential. The site is located within an area that has not been mapped by the Division of Mines and Geology nor is designated by the State of California as having potential for liquefaction. It is anticipated that major earthquake groundshaking will occur during the lifetime of the proposed development from the seismically active Elsinore Fault and San Jacinto Fault. These are the known faults that would create the most significant earthshaking event.

Liquefaction describes a phenomenon in which cyclic stresses, produced by earthquake-induced ground motion, create excess pore pressures in relatively cohesionless soils. These soils may acquire a high degree of mobility which can lead to lateral movement, sliding, settlement of loose sediments, sand boils and other damaging deformations. This phenomenon occurs only below

the water table, but, after liquefaction has developed, the effects can propagate upward into overlying non-saturated soil as excess pore water dissipates.

The factors known to influence liquefaction potential include soil type and grain size, relative density, groundwater level, confining pressures, and both intensity and duration of ground shaking. In general, materials that are susceptible to liquefaction are loose, saturated granular soils having low fines content under low confining pressures.

GeoTek utilized a methodology to evaluate liquefaction as presented by Idriss and Boulanger, 2008. The referenced USGS website was used to deaggregate the seismic hazards (faults) contributing to the site's seismic ground motion potential. Considering an exceedance probability of two percent in 50 years (i.e. 2,475-year return period), a magnitude weight (M_w) earthquake of M6.9 yields a predicted peak horizontal ground acceleration of 0.5g.

The standard penetration data obtained in exploratory Boring B-2 provided input for the LiquefyPro Version 5.8n program for liquefaction-induced settlement. Our field investigation noted groundwater in exploratory Boring B-2 at the approximate depth of 43 feet; however, based on regional groundwater data reported in the vicinity of the site, a groundwater depth of 36 feet was utilized for analysis. Due to the presence of groundwater, we evaluated the risk for liquefaction.

As recommended by the State of California Special Publication 117, our seismic settlement analysis has incorporated a safety factor of 1.3.

Using the information presented in Table 3 of the referenced publication by Idriss and Boulanger, an analysis was conducted to determine the sampler correction factor C_s. The SPT sampler is machined to fit liners, therefore a correction factor of 1.0 may not be appropriate. The liquefaction analysis reveals that the $(N_1)_{60}$ values between depths of 1.5 feet to 33.5 feet and 36.5 feet to 50.5 feet are greater than 30. Since this is the great majority of the boring, a C_S value of 1.3 was used in our LiquefyPro calculation.

Based on the interior diameter of the flight-auger of 4.3 inches, the value for C_B that was used in our analysis was 1.0.

The results of this evaluation indicated that minor near surface sandy layers may be subject to dry settlement, but the underlying dense bedrock is not susceptible to adverse levels of seismic induced settlement. The results of our evaluation are shown in Appendix C. Our analysis revealed a seismic-induced settlement potential of approximately 0.15-inch.

The total settlement will occur over a large area and will not affect local buried utilities. Within the building area, we would estimate the total differential dynamic settlement would be about one-half the total. Based on a minimum building dimension of approximately 41 feet, a maximum angular distortion of about 1/6,560 is calculated, which is within tolerable limits. It is our opinion that liquefaction should not be a consideration in the design of the structures.

4.7 OTHER SEISMIC HAZARDS

Based on the Riverside County Parcel Report, the site is susceptible to subsidence. Any subsidence in the area would likely be regional and not adversely affect the subject development specifically.

Evidence of ancient landslides or slope instability at this site was not observed during our investigation and the project site is relatively flat. Thus, the potential for landslides is considered negligible for design purposes.

The potential for secondary seismic hazards such as a seiche or tsunami is considered negligible due to site elevation and distance to an open body of water.

The City of Perris General Plan Safety Element indicates that the site is near or within a potential dam inundation plain of four reservoirs: Pigeon Pass Reservoir to the north in the City of Moreno Valley, Lake Perris Reservoir to the immediate northeast, Little Lake Reservoir to the east in Hemet and Diamond Valley Lake to the southeast. The project's civil engineer should adjust site grades to mitigate this should major flooding occur due to dam failure.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 GENERAL

The anticipated site development appears feasible from a geotechnical viewpoint provided that the following recommendations, and those provided by this firm at a later date, are incorporated into the design and construction phases of development. Grading and foundation plans should be reviewed by GeoTek when they become available, so our recommendations can be confirmed.

The site is underlain by alluvium that is relatively dense. Based on the results of our test borings, in order to provide uniform foundation support, overexcavation and compaction of the upper five feet of natural soil below and within five feet of the buildings is recommended.

On-site soils exhibit a "very low" expansion potential. Expansion index testing should be conducted at the completion of earthwork operations to verify these design conditions.

5.2 EARTHWORK CONSIDERATIONS

Earthwork and grading should be performed in accordance with the applicable grading ordinances of the City of Perris, the County of Riverside, the 2016 California Building Code (CBC) and recommendations contained in this report. The Grading Guidelines included in Appendix E outline general procedures and do not anticipate all site-specific situations. In the event of conflict, the recommendations presented in the text of this report should supersede those contained in Appendix E.

5.2.1 Site Clearing and Demolition

Site preparation should start with demolition/razing of existing site improvements and removal of deleterious materials and vegetation. Debris should be properly disposed off-site. Voids resulting from site clearing should be backfilled with engineered fill.

5.2.2 Building Footings and Floor-Slabs

Undocumented fill was noted in exploratory Boring B-1 to a depth of 4.5 feet. All undocumented fill encountered during earthwork operations below and within five feet of the building should be removed until natural soil is encountered.

The soils below and within five feet of the building footings and on-grade concrete floor-slabs should be overexcavated to a depth of five feet below existing grade or three feet below the bottom of the footings and floor slabs, whichever is greater. The excavated soil may be stockpiled on-site for future use. A representative of this firm should observe the bottom of all excavations. If competent natural soil is encountered prior to achieving the required vertical limits of removal, the excavation may be terminated as long as there is at least two feet of overexcavated and recompacted soil below the bottom of the footings and floor-slabs. Competent natural soil is defined as relatively non-porous material exhibiting a relative compaction of at least 85 percent (ASTM D 1557).

5.2.3 Preparation of Excavation Bottoms

Upon approval, the exposed soils and soils in areas to receive engineered fill should be moistened to at least the optimum moisture content and densified to a minimum relative compaction of 90 percent (ASTM D 1557).

5.2.4 Horizontal Extent of Removals

In areas where removal depths exceed five feet below the proposed building and screen wall footings, the horizontal limits of removals outside the perimeter of these structural elements should be equal to the depth of the soil removals below the bottom of the footings.

5.2.5 Hardscape Areas

The soils below proposed hardscape areas should be observed by a representative of this firm. All undocumented fill should be removed below hardscape areas. The upper 12 inches of natural soil below hardscape areas should be moistened to at least the optimum moisture content and densified to a minimum relative compaction of 90 percent (ASTM D 1557).

5.2.6 Engineered Fills

The on-site materials are generally considered suitable for reuse as engineered fill provided they are free from vegetation, debris, and other deleterious material. The undercut areas should be brought to the final subgrade elevations with fill materials that are placed in loose lifts of eight inches or less, moisture conditioned to at least the optimum moisture content and compacted to a minimum relative compaction of 90 percent (ASTM D 1557).

5.2.7 Import Soils

Import soils should have a "very low" expansion potential. GeoTek recommends that the proposed import soils be tested for expansion and corrosivity potential. GeoTek should be notified a minimum of 72 hours prior to importing so that appropriate sampling and laboratory testing can be performed.

5.2.8 Excavation Characteristics

Excavation of the on-site soils is expected to be feasible with heavy-duty grading equipment in good operating condition.

5.2.9 Temporary Excavations

All temporary excavations for grading purposes and installation of underground utilities should be constructed in accordance with local and Cal-OSHA guidelines. Temporary excavations within the on-site materials should be stable at 1:1 (h:v) inclinations for cuts less than 10 feet in height. Excavations should be observed by a representative of GeoTek.

5.2.10 Shrinkage/Bulking and Subsidence

Several factors will impact earthwork balancing on the site, including shrinkage, subsidence, trench spoil from utilities and footing excavations, as well as the accuracy of topography.

Shrinkage is primarily dependent upon the degree of compactive effort achieved during construction. For planning purposes, a shrinkage factor of up to 10 percent may be considered for the materials requiring removal and/or recompaction. Site balance areas should be available in order to adjust project grades, depending on actual field conditions at the conclusion of site earthwork construction. Subsidence of up to 0.10-foot may be anticipated for areas to receive fill.

5.3 DESIGN RECOMMENDATIONS

5.3.1 Foundation Design Criteria

The warehouse buildings will be supported by conventional shallow isolated and continuous footings. Design criteria for a conventional foundation system are presented in general conformance with the 2016 CBC. These are typical design criteria and are not intended to supersede the design by the structural engineer.

Our investigation indicates that the on-site soils have a "very low" expansion potential.

Additional expansion index and soluble sulfate testing of the soils should be performed during construction to evaluate the as-graded conditions. Final recommendations should be based upon the as-graded soils conditions.

A summary of our foundation design recommendations is presented in the following table:

MINIMUM DESIGN REQUIREMENTS FOR CONVENTIONALLY REINFORCED SPREAD FOUNDATIONS	
DESIGN PARAMETER	**"VERY LOW" EXPANSION POTENTIAL 0≤EI≤20**
Foundation Depth or Minimum Perimeter Beam Depth (inches below lowest adjacent grade)	One- and two-story – 12
Minimum Foundation Width (inches)*	12
Minimum Slab Thickness (inches)	4 - Actual
Sand Blanket and Moisture Retardant Membrane Below On-Grade Building Slabs	Two inches of sand** overlying moisture vapor retardant membrane overlying two inches of sand**
Minimum Slab Reinforcing	6" x 6" – W2.9/W2.9 welded wire fabric placed in middle of slab or No. 3 rebar 24 inches on-center, each way, placed in middle of slab
Minimum Reinforcement for Continuous Footings, Grade Beams, and Retailing Wall Footings	Two No. 4 reinforcing bars, one placed near the top and one near the bottom
Presaturation of Subgrade Soil (Percent of Optimum/Depth in Inches)	Minimum 100% of the optimum moisture content to a depth of at least 12 inches prior to placing concrete

* Code minimums per Table 1809.7 of the 2016 CBC
** Sand should have a sand equivalent of at least 30

It should be noted that the criteria provided are based on soil support characteristics only. The structural engineer should design the slab reinforcement based on actual loading conditions.

An allowable bearing capacity of 2,000 psf may be used for design of building footings and footings supporting site walls with a minimum width and depth of 12 inches. This value may be increased by 400 psf for each additional 12 inches in depth and 400 psf for each additional 12 inches in width to a maximum value of 3,500 psf. An increase of one-third may be applied when considering short-term seismic and wind loads.

Structural foundations may be designed in accordance with the 2016 CBC, and to withstand a total static settlement of one inch and maximum differential settlement of one-half of the total settlement over a horizontal distance of 40 feet.

The passive earth pressure may be computed as an equivalent fluid having a density of 300 psf per foot of depth, to a maximum earth pressure of 2,500 psf for footings founded on engineered fill. A coefficient of friction between soil and concrete of 0.30 may be used with dead load forces. Unless the adjacent ground is covered with pavement, the upper one foot of soil below the

adjacent grade should not be used in calculating passive pressure. When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one-third.

The above values may be increased as allowed by Code to resist short-term transient loads.

A moisture and vapor retarding system should be placed below slabs-on-grade where moisture migration through the slab is undesirable. Guidelines for these are provided in the 2016 California Green Building Standards Code (CALGreen) Section 4.505.2, the 2016 CBC Section 1907.1 and ACI 360R-10. The vapor retarder design and construction should also meet the requirements of ASTM E 1643. A portion of the vapor retarder design should be the implementation of a moisture vapor retardant membrane.

It should be realized that the effectiveness of the vapor retarding membrane can be adversely impacted as a result of construction related punctures. These occurrences should be limited as much as possible during construction. Thicker membranes are generally more resistant to accidental puncture than thinner ones. Products specifically designed for use as moisture/vapor retarders may also be more puncture resistant. Although the CBC specifies a 6 mil vapor retarder membrane, a minimum 10 mil thick membrane with joints properly overlapped and sealed should be considered, unless otherwise specified by the slab design professional. The membrane should consist of Stego wrap or the equivalent.

A two-inch layer of clean sand with a sand equivalent of at least 30 should be placed over the moisture vapor retardant membrane to promote setting of the concrete. The moisture in the sand should not exceed two percent below the optimum moisture content.

Moisture and vapor retarding systems are intended to provide a certain level of resistance to vapor and moisture transmission through the concrete, but do not eliminate it. The acceptable level of moisture transmission through the slab is to a large extent based on the type of flooring used and environmental conditions. Ultimately, the vapor retarding system should be comprised of suitable elements to limit migration of water and reduce transmission of water vapor through the slab to acceptable levels. The selected elements should have suitable properties such as thickness, composition, strength, and permeability to achieve the desired performance level.

Moisture retarders can reduce, but not eliminate, moisture vapor rise from the underlying soils up through the slab. Moisture retarder systems should be designed and constructed in

accordance with applicable American Concrete Institute, Portland Cement Association, Post-Tensioning Concrete Institute, ASTM and California Building Code requirements and guidelines.

GeoTek recommends that a qualified person, such as a flooring contractor, structural engineer, architect, and/or other experts specializing in moisture control within buildings be consulted to evaluate the general and specific moisture and vapor transmission paths and associated potential impact on the proposed construction. That person should provide recommendations relative to the slab moisture and vapor retarder systems and for migration of potential adverse impact of moisture vapor transmission on various components of the structures, as deemed appropriate.

In addition, the recommendations in this report and our services in general are not intended to address mold prevention, since we, along with geotechnical consultants in general, do not practice in the area of mold prevention. If specific recommendations addressing potential mold issues are desired, then a professional mold prevention consultant should be contacted.

We recommend that control joints be placed in two directions spaced approximately 24 to 36 times the thickness of the slab in inches. These joints are a widely accepted means to control cracks and should be reviewed by the project structural engineer.

5.3.2 Miscellaneous Foundation Recommendations

To reduce moisture penetration beneath the slab on grade areas, utility trenches should be backfilled with engineered fill, lean concrete, or concrete slurry where they intercept the perimeter footing or thickened slab edge.

Soils from the footing excavations should not be placed in the slab-on-grade areas unless properly compacted and tested. The excavations should be free of loose/sloughed materials and be neatly trimmed at the time of concrete placement.

5.3.3 Foundation Setbacks

The top outside edge of the new footings should have a minimum setback of five feet from the face of an adjacent slope.

The bottom of an proposed foundations for structures should be deepened to as to extend below a 1:1 projection extending upward from the bottom of the nearest excavation.

5.3.4 Soil Corrosivity

Based on the chemical test results presented in Appendix B, the corrosivity test results indicate that the on-site soils are "corrosive" to buried ferrous metal. This corrosion classification is

obtained from "Corrosion Basics: An Introduction," by Pierre R. Roberge, 2nd Edition, 2005. Recommendations for protection of buried ferrous metal should be provided by a corrosion engineer.

5.3.5 Soil Sulfate Content

Based on the chemical test results presented in Appendix B, the sulfate test results on a sample obtained from the project site indicate a soluble sulfate content of less than 0.1 percent by weight should be expected. Soluble sulfate contents of this level would be in the range of "not applicable" (i.e. negligible) in accordance with Table 4.2.1 of ACI 318. Based on the test results and Table 4.3.1 of ACI 318, no special concrete mix design will be necessary to resist sulfate attack.

5.3.6 Concrete Flatwork

5.3.6.1 Exterior Concrete Slabs, Sidewalks, and Driveways

Exterior concrete slabs, sidewalks and driveways should be designed using a four-inch minimum thickness. Some shrinkage and cracking of the concrete should be anticipated as a result of typical mix designs and curing practices utilized in construction.

Sidewalks may be under the jurisdiction of the governing agency. If so, jurisdictional design and construction criteria will apply, if more restrictive than the recommendations presented in this report.

Subgrade soils should be pre-moistened prior to placing concrete. The subgrade soils with a "very low" expansion potential should be pre-saturated to a minimum of 100 percent of the optimum moisture content to a depth of 12 inches.

All concrete installation, including preparation and compaction of subgrade, should be done in accordance with the City of Perris specifications, and under the observation and testing of GeoTek, Inc. and a City or County inspector, if necessary.

5.3.6.2 Concrete Performance

Concrete cracks should be expected. These cracks can vary from sizes that are essentially unnoticeable to more than 1/8 inch in width. Most cracks in concrete, while unsightly, do not significantly impact long-term performance. While it is possible to take measures (proper concrete mix, placement, curing, control joints, etc.) to reduce the extent and size of cracks that occur, some cracking will occur despite the best efforts to minimize it. Concrete undergoes chemical processes that are dependent on a wide range of variables which are difficult, at best,

to control. Concrete, while seemingly a stable material, is subject to internal expansion and contraction due to external changes over time.

One of the simplest means to control cracking is to provide weakened control joints for cracking to occur along. These do not prevent cracks from developing; they simply provide a relief point for the stresses that develop. These joints are a widely accepted means to control cracks but are not always effective. Control joints are more effective the more closely spaced they are. GeoTek, Inc. suggests that control joints be placed in two directions and located a distance apart approximately equal to 24 to 36 times the slab thickness.

5.4 POST CONSTRUCTION CONSIDERATIONS

5.4.1 Landscape Maintenance and Planting

Water has been shown to weaken the inherent strength of soil, and slope stability is significantly reduced by overly wet conditions. Positive surface drainage away from graded slopes should be maintained and only the amount of irrigation necessary to sustain plant life should be provided for planted slopes. Controlling surface drainage and runoff and maintaining a suitable vegetation cover can minimize erosion. Plants selected for landscaping should be lightweight, deep-rooted types that require little water and are capable of surviving the prevailing climate.

Overwatering should be avoided. An abatement program to control ground-burrowing rodents should be implemented and maintained. Burrowing rodents can decrease the long-term performance of slopes.

It is common for planting to be placed adjacent to structures in planter or lawn areas. This will result in the introduction of water into the ground adjacent to the foundations. This type of landscaping should be avoided.

5.4.2 Drainage

Positive site drainage should be maintained at all times. Drainage should not flow uncontrolled down any descending slope. Water should be directed away from foundations and not allowed to pond or seep into the ground adjacent to the footings and floor-slabs. Pad drainage should be directed toward approved areas and not be blocked by other improvements.

Roof gutters should be installed that will direct the collected water at least 20 feet from the building, or to another suitable location.

5.5 PLAN REVIEW AND CONSTRUCTION OBSERVATIONS

We recommend that specifications and foundation and grading plans be reviewed by this office prior to construction to check for conformance with the recommendations of this report. We also recommend that GeoTek representatives be present during site grading and foundation construction to observe and document proper implementation of the geotechnical recommendations. The owner/developer should verify that GeoTek representatives perform at least the following duties:

- Observe site clearing and grubbing operations for proper removal of unsuitable materials.
- Observe and test bottom of removals prior to fill placement.
- Evaluate the suitability of on-site and import materials for fill placement and collect soil samples for laboratory testing where necessary.
- Observe the fill for uniformity during placement, including utility trench backfill. Perform field density testing of the fill materials.
- Observe and probe foundation excavations to confirm suitability of bearing materials with respect to density.

If requested, a construction observation and compaction report can be provided by GeoTek which can comply with the requirements of the governmental agencies having jurisdiction over the project. We recommend that these agencies be notified prior to commencement of construction so that necessary grading permits can be obtained.

6. INTENT

It is the intent of this report to aid in the design and construction of the proposed development. Implementation of the advice presented in this report is intended to reduce risk associated with construction projects. The professional opinions and geotechnical advice contained in this report are not intended to imply total performance of the project or guarantee that unusual or variable conditions will not be discovered during or after construction.

The scope of our evaluation is limited to the boundaries of the subject property. This review does not and should in no way be construed to encompass any areas beyond the specific area of the proposed construction as indicated to us by the client. Further, no evaluation of any existing site improvements is included. The scope is based on our understanding of the project and the

client's needs, our fee estimate (Proposal No. P-0601319) dated June 7, 2019 and geotechnical engineering standards normally used on similar projects in this locality.

7. LIMITATIONS

Our findings are based on site conditions observed and the stated sources. Thus, our comments are professional opinions that are limited to the extent of the available data.

GeoTek has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practicing under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report.

Since our recommendations are based on the site conditions observed and encountered, and laboratory testing, our conclusions and recommendations are professional opinions that are limited to the extent of the available data. Observations during construction are important to allow for any change in recommendations found to be warranted. These opinions have been derived in accordance with current standards of practice and no warranty of any kind is expressed or implied. Standards of care/practice are subject to change with time.

8. SELECTED REFERENCES

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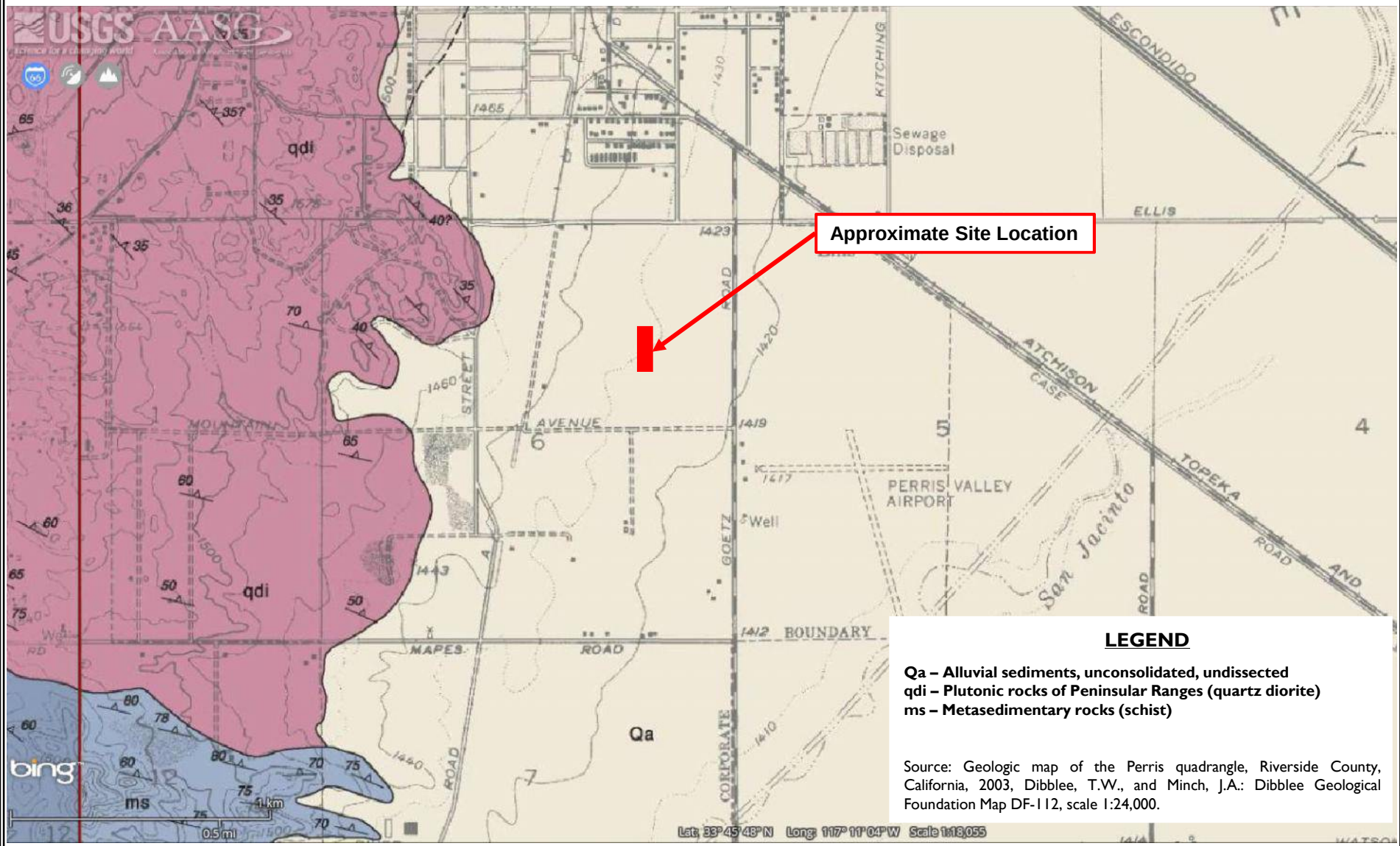
KSP Studio
Proposed Warehouse Development
24 Malbert Road, APN 330-040-062
Perris, Riverside County, California
GeoTek Project No. 2156-CR

N

Figure 1

Site Location Map

GEOTEK



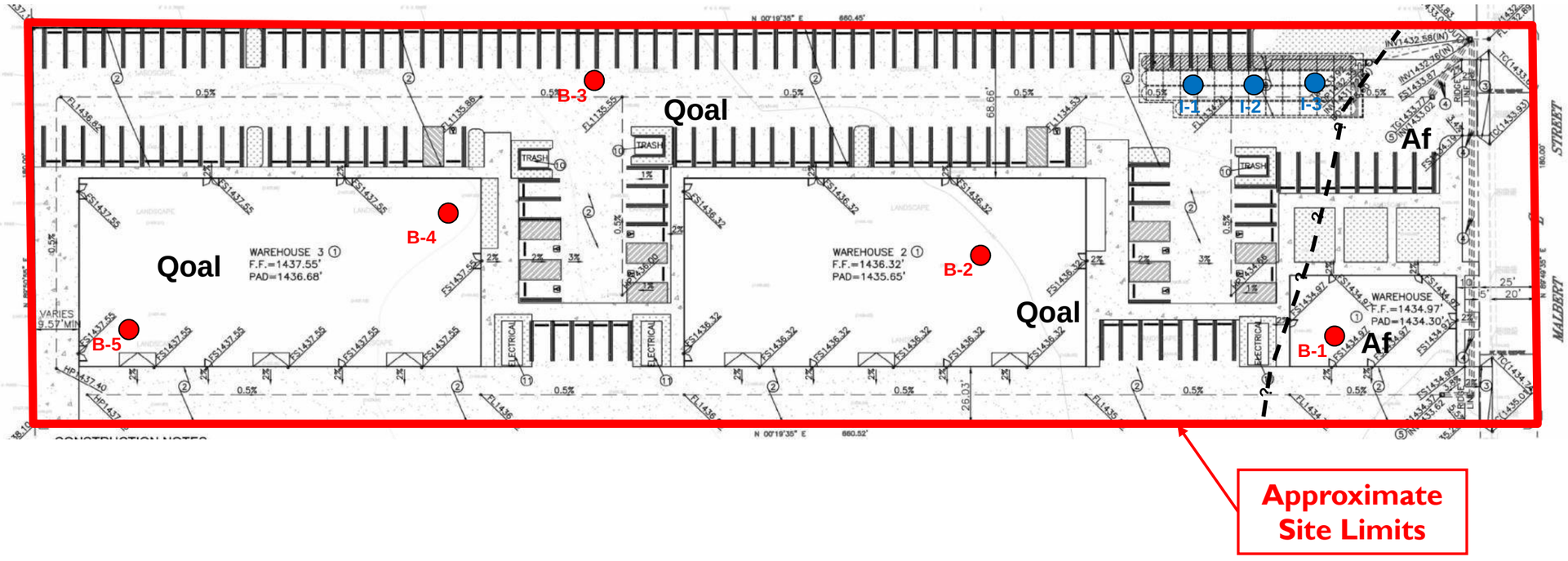
KSP Studio
Proposed Warehouse Development
24 Malbert Road, APN 330-040-062
Perris, Riverside County, California
GeoTek Project No. 2156-CR

N

Figure 2

Geologic Map

GEOTEK



Legend
(Locations are approximate)

Geologic Units

Af - Artificial Fill

Qoal - Older Alluvium

B-5 - Exploratory Boring

I-3 - Infiltration Boring

- - - - - - - Geologic Contact

Scale: 1" ~ 55'

Source: *Preliminary Grading Plan,* prepared by David Li & Associates, with revisions dated 3/21/18,

KSP Studio
Proposed Warehouse Development
24 Malbert Road, APN 330-040-062
Perris, Riverside County, California
GeoTek Project No. 2156-CR

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Figure 3

Exploration Location Map

APPENDIX A

LOGS OF EXPLORATORY BORINGS

Proposed Warehouse Development
24 Malbert Street
Perris, Riverside County, California
Project No. 2156-CR

GEOTEK

A - FIELD TESTING AND SAMPLING PROCEDURES

The Modified Split-Barrel Sampler (Ring)

The Ring sampler is driven into the ground in accordance with ASTM Test Method D 3550. The sampler, with an external diameter of 3.0 inches, is lined with 1-inch long, thin brass rings with inside diameters of approximately 2.4 inches. The sampler is typically driven into the ground 12 or 18 inches with a 140-pound hammer free falling from a height of 30 inches. Blow counts are recorded for every 6 inches of penetration as indicated on the log of boring. The samples are removed from the sample barrel in the brass rings, sealed, and transported to the laboratory for testing.

Bulk Samples (Large)

These samples are normally large bags of earth materials over 20 pounds in weight collected from the field by means of hand digging or exploratory cuttings.

B – BORING/TRENCH LOG LEGEND

The following abbreviations and symbols often appear in the classification and description of soil and rock on the logs of borings/trenches:

SOILS

USCS	Unified Soil Classification System
f-c	Fine to coarse
f-m	Fine to medium

GEOLOGIC

B: Attitudes	Bedding: strike/dip
J: Attitudes	Joint: strike/dip
C: Contact line	
……..	Dashed line denotes USCS material change
———	Solid Line denotes unit / formational change
———	Thick solid line denotes end of boring/trench

(Additional denotations and symbols are provided on the log of borings/trenches)

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	KSP Studios	**DRILLER:**	2R	**LOGGED BY:**	KM
PROJECT NAME:	Perris Warehouse	**DRILL METHOD:**	Hollow Stem Auger	**OPERATOR:**	Ish
PROJECT NO.:	2156-CR	**HAMMER:**	140lbs/30in.	**RIG TYPE:**	Truck
LOCATION:	See Exploration Location Map			**DATE:**	6/26/2019

BORING NO.: B-1 Sheet 1 of 1

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
					Undocumented Fill			
	■	25 50/5"	R1	SM	Silty f SAND, light brown, slightly moist, very dense, roots present	5.1	129.1	
5					**Alluvium**			
	■	20 35 45	R2	SM	Silty f-m SAND, olive brown, slightly moist, very dense	5.2	128.5	
	■	50/5"	R3			6.0	122.7	
10								
	■	14 30 50/4"	R4		Silty f-c SAND, orangish brown, slightly moist, very dense	6.1	127.6	
15	■	27 50/5"	R5					
20	■	20 41 46	R6		- becoming moist at 20 feet			
					BORING TERMINATED AT 21.5 FEET			
					No groundwater encountered Boring backfilled with soil cuttings			
25								
30								

LEGEND

Sample type: ■ ---Ring ■ ---SPT ▨ ---Small Bulk ▩ ---Large Bulk □ ---No Recovery ▽ ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	KSP Studios	**DRILLER:**	2R	**LOGGED BY:**	KM
PROJECT NAME:	Perris Warehouse	**DRILL METHOD:**	Hollow Stem Auger	**OPERATOR:**	Ish
PROJECT NO.:	2156-CR	**HAMMER:**	140lbs/30in.	**RIG TYPE:**	Truck
LOCATION:	See Exploration Location Map			**DATE:**	6/26/2019

BORING NO.: B-2 Sheet 1 of 2

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
					Alluvium			
		18 29 40	R1	SM	Silty f-m SAND, brown, slightly moist, very dense	5.9	133.4	MD, EI, SR, SH
		26 50/6"	R2			5.2	128.8	
5		29 35 40	R3		- trace gravel at 5 feet	4.0	128.4	
		27 50/5"	R4			3.0	130.0	
10		22 40 32	R5	SM	Silty f SAND, orangish brown, slightly moist, dense	7.3	131.6	
		20 25 30	R6		- becoming moist at 12 feet	9.8	114.2	-#200 = 30.5% AL: Non-Plastic
15		21 47 50/3"	R7	SM	Silty f-c SAND, olive brown, slightly moist, very dense	5.3	129.8	
20		36 50/5"	R8		- becoming f grained at 20 feet	6.5	128.3	
25		50/5"	R9		- becoming f-m grained at 25 feet	7.1	124.8	
30		12 15 17	S1	SM-SC	Silty f SAND to clayey f SAND, brown, moist, medium dense, micaceous			-#200 = 33.5% AL: LL = 26, PI = 5

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	KSP Studios	**DRILLER:**	2R	**LOGGED BY:**	KM
PROJECT NAME:	Perris Warehouse	**DRILL METHOD:**	Hollow Stem Auger	**OPERATOR:**	Ish
PROJECT NO.:	2156-CR	**HAMMER:**	140lbs/30in.	**RIG TYPE:**	Truck
LOCATION:	See Exploration Location Map			**DATE:**	6/26/2019

BORING NO.: B-2 Sheet 2 of 2

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
35		5 9 14	S2					AL: Non-Plastic
40		50/3"	S3		**Granitic Bedrock** F-c SAND, black and white, very moist to wet, very dense			
	▽							
45		50/3"	S4					
50		50/6"						
					BORING TERMINATED AT 50.5 FEET Groundwater encountered at 43 feet Boring backfilled with soil cuttings			

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	KSP Studios	**DRILLER:**	2R	**LOGGED BY:**	KM
PROJECT NAME:	Perris Warehouse	**DRILL METHOD:**	Hollow Stem Auger	**OPERATOR:**	Ish
PROJECT NO.:	2156-CR	**HAMMER:**	140lbs/30in.	**RIG TYPE:**	Truck
LOCATION:	See Exploration Location Map			**DATE:**	6/26/2019

BORING NO.: B-3 Sheet 1 of 1

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				SM	**Alluvium** Silty f SAND, light brown, slightly moist, very dense			
		50/5"	R1			4.8	108.3	
5		17 14 14	R2		- becoming f-m grained at 5 feet	2.2	121.7	
		25 36 42	R3	SP	M SAND with trace SILT, light brown, slightly moist, very dense	3.7	130.3	
10		27 47 50/4"	R4	SM-ML	Silty f SAND to sandy SILT, light brown, moist, very dense	10.2	129.2	
15		27 50/5"	R5	SP	F-m SAND with trace SILT, brown, moist, very dense			
20		14 41 50/5"	R6					
					BORING TERMINATED AT 21.5 FEET No groundwater encountered Boring backfilled with soil cuttings			
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	KSP Studios	**DRILLER:**	2R	**LOGGED BY:**	KM
PROJECT NAME:	Perris Warehouse	**DRILL METHOD:**	Hollow Stem Auger	**OPERATOR:**	Ish
PROJECT NO.:	2156-CR	**HAMMER:**	140lbs/30in.	**RIG TYPE:**	Truck
LOCATION:	See Exploration Location Map			**DATE:**	6/26/2019

BORING NO.: B-4 Sheet 1 of 1

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				SP	**Alluvium** M-c SAND, light brown, slightly moist, medium dense			
5		3 5 10	R1			3.2	114.2	
10		30 50/5"	R2	SM	Silty f-m SAND, brown, slightly moist, very dense	6.1	134.1	
15		17 32 50/5"	R3		Silty f SAND, light brown, slightly moist, very dense	6.2	129.4	
20		27 38 48	R4		- becoming moist at 19 feet			
25					**BORING TERMINATED AT 20.5 FEET** No groundwater encountered Boring backfilled with soil cuttings			
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	KSP Studios	**DRILLER:**	2R	**LOGGED BY:**	KM
PROJECT NAME:	Perris Warehouse	**DRILL METHOD:**	Hollow Stem Auger	**OPERATOR:**	Ish
PROJECT NO.:	2156-CR	**HAMMER:**	140lbs/30in.	**RIG TYPE:**	Truck
LOCATION:	See Exploration Location Map			**DATE:**	6/26/2019

BORING NO.: B-5 Sheet 1 of 1

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				SP	**Alluvium** F-m SAND, light brown, slightly moist, medium dense			
		9 10 10				2.1	118.1	
5		4 9 18			- becoming m-c grained at 5 feet	3.2	115.4	
10		24 43 50/4		SM	Silty f SAND, brown, slightly moist, very dense	7.3	135.5	
15		7 10 16			Silty f-m SAND with some clay, brown, moist, medium dense	10.2	127.2	HC
20		18 40 50			Silty f-m sand, brown, moist, very dense			
					BORING TERMINATED AT 21.5 FEET No groundwater encountered Boring backfilled with soil cuttings			
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

APPENDIX B

LABORATORY TEST RESULTS

Proposed Warehouse Development
24 Malbert Street
Perris, Riverside County, California
Project No. 2156-CR

GEOTEK

SUMMARY OF LABORATORY TESTING

Classification

Soils were classified visually in general accordance to the Unified Soil Classification System (ASTM Test Method D 2487). The soil classifications are shown on the boring logs in Appendix A.

In-Situ Moisture and Density

The natural water content was determined (ASTM D 2216) on samples of the materials recovered during the subsurface exploration. In addition, in-place dry density determinations (ASTM D 2937) were performed on relatively undisturbed samples to measure the unit weight of the subsurface soils. Results of these tests are shown on the boring logs at the appropriate sample depths in Appendix A.

Materials Finer Than the No. 200 Sieve

A #200 sieve wash was performed on selected samples of the soils according to ASTM Test Method D 1140. The results of this testing are presented on the boring logs in Appendix A.

Moisture-Density Relationship

Laboratory testing was performed on a sample obtained during the subsurface exploration. The laboratory maximum dry density and optimum moisture content was determined in general accordance with ASTM D 1557. The results of the testing are provided below.

Boring No.	Depth (ft.)	Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
B-2	0-5	Silty f-m sand	133.0	8.0

Expansion Index

The expansion potential of the soils was determined by performing expansion index testing on a sample in general accordance with ASTM D 4829. The result of the testing is provided below.

Boring No.	Depth (ft.)	Soil Type	Expansion Index	Classification
B-2	0-5	Silty f-m sand	12	Very Low

Atterberg Limits

Atterberg limit testing was determined on a sample obtained during the subsurface exploration in general accordance with ASTM D 4318. The result of the testing is provided below and are shown on the boring logs in Appendix A.

Boring No.	Depth (ft.)	Soil Type	Liquid Limit	Plastic Limit	Plasticity Index
B-2	13	Silty f sand	0	0	0
B-2	30	Silty f sand to clayey f sand	26	21	5
B-2	35	Silty f sand	0	0	0

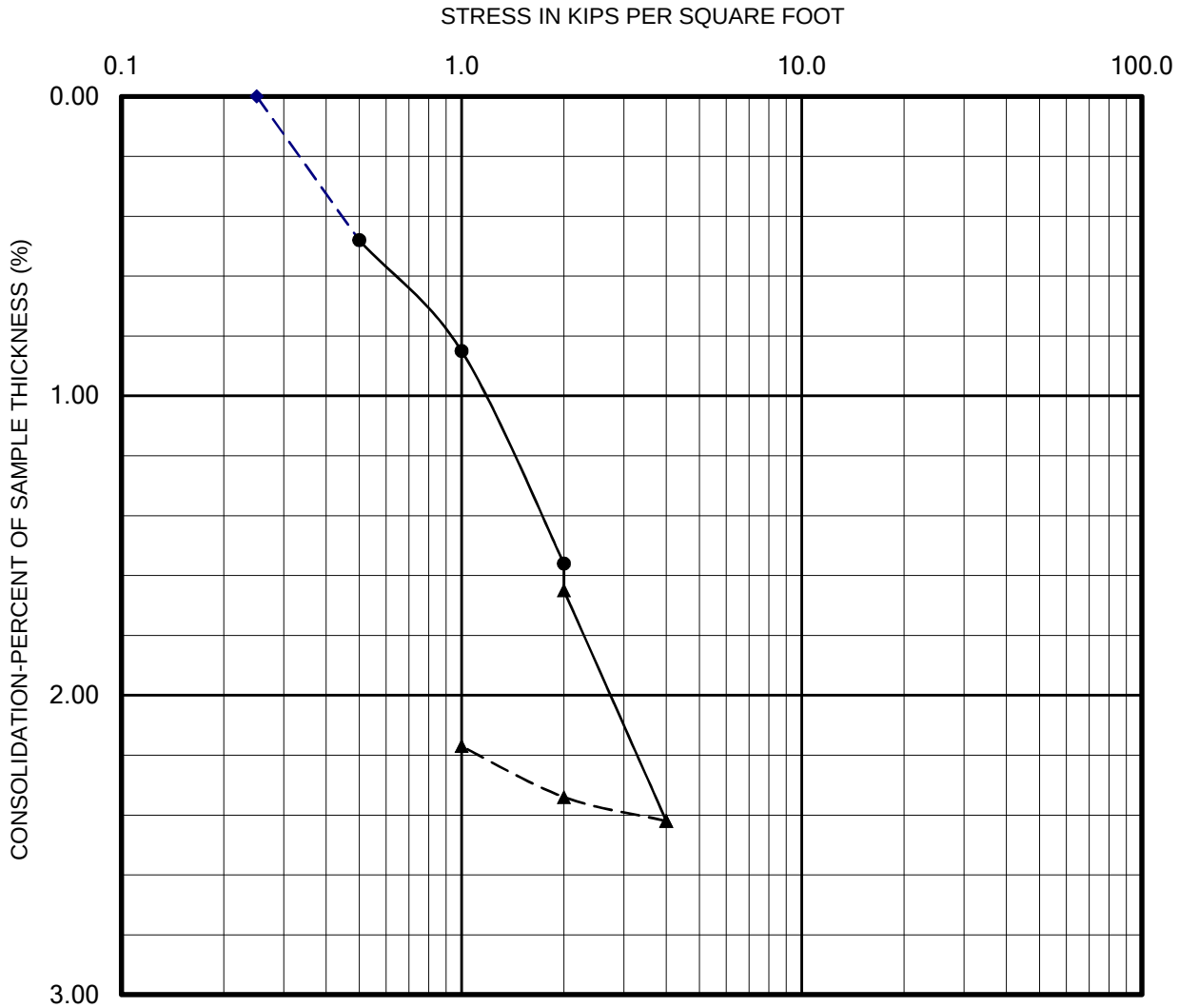
Consolidation
The compressibility characteristics of the soils were evaluated by performing consolidation testing on three samples in general accordance with ASTM D 2435. The results are included in Appendix B.

Direct Shear
The shear strength characteristics of on-site soils were determined by performing direct shear testing on a sample in general accordance with ASTM D 3080. The soil sample was remolded to approximately 90 percent relative compaction from a bulk sample collected during the investigation. The result of the testing is provided below and in Appendix B.

Boring No.	Depth (ft.)	Soil Type	Friction Angle, degrees	Cohesion, psf
B-2	0-5	Silty f-m sand	29	282

Soil Corrosivity
Testing to determine the corrosivity characteristics of the on-site soils were determined by others. The results of the testing and their corresponding test methods are provided below.

Boring No.	Depth (ft.)	pH ASTM G51	Chloride ASTM D4327 (ppm)	Sulfate ASTM 4327 (% by weight)	Resistivity ASTM G187 (ohm-cm)
B-2	0-5	8.0	8.6	0.0042	4,087



Seating Cycle
Loading Prior to Inundation
Loading After Inundation
Rebound Cycle

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435

GEOTEK

CHECKED BY: NCT	Lab: Corona
PROJECT NO.: 2156-CR	Date: 7/16/19

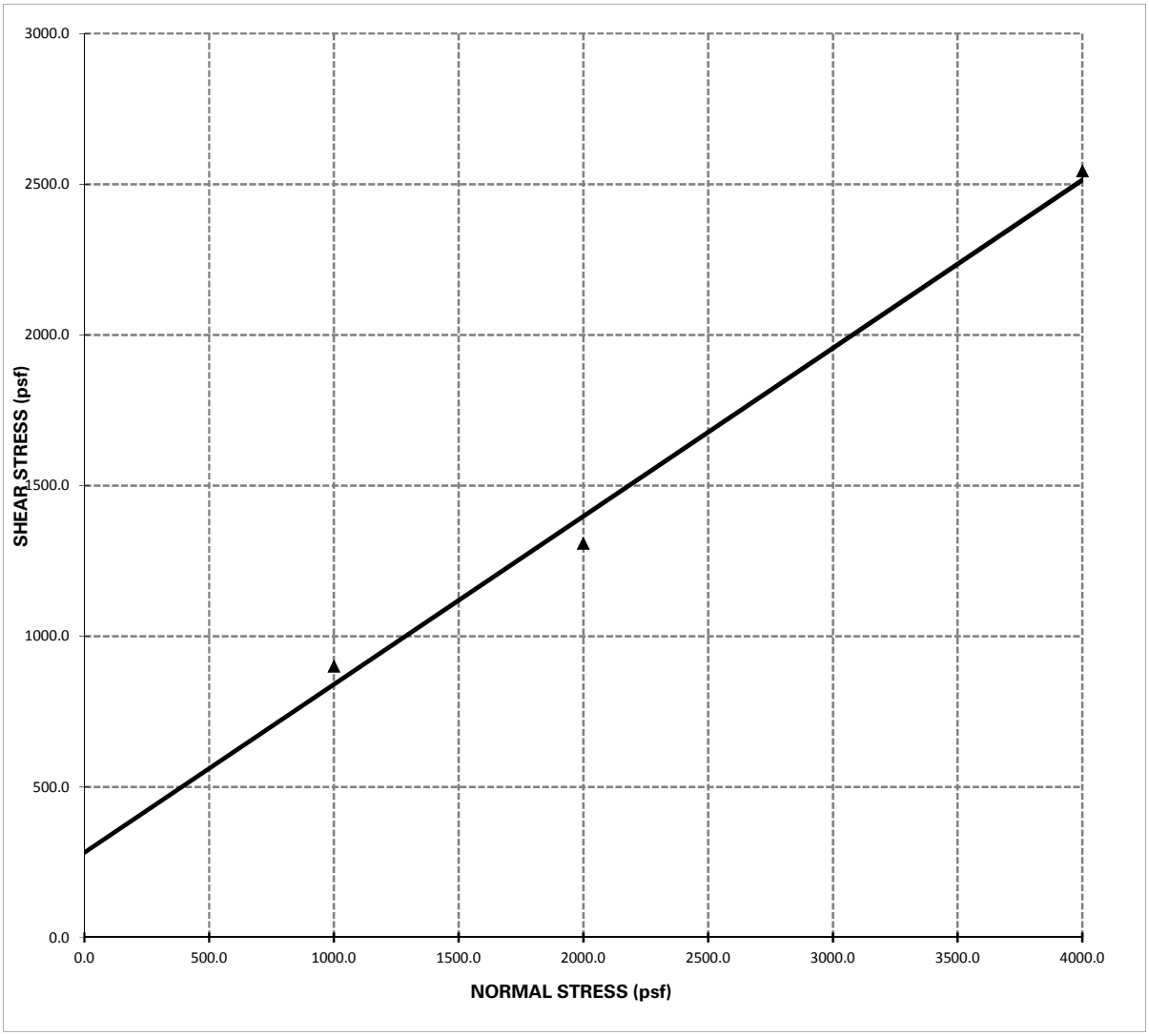
CONSOLIDATION REPORT

Sample:
B-5 @ 15

Plate B-1

DIRECT SHEAR TEST

Project Name:	Perris Warehouse	***Sample Location:***	B-2 @ 0 - 5
Project Number:	2156-CR	***Date Tested:***	7/16/2019



Shear Strength: Φ = **29.2** ° , **C = 282.00 psf**

Notes: 1 - The soil specimen used in the shear box was a ring sample remolded to approximately 90% relative compaction from a bulk sample collected during the field investigation.

2 - The above reflect direct shear strength at saturated conditions.

3 - The tests were run at a shear rate of 0.035 in/min.

APPENDIX C

SETTLEMENT ANALYSIS

Proposed Warehouse Development
24 Malbert Street
Perris, Riverside County, California
Project No. 2156-CR

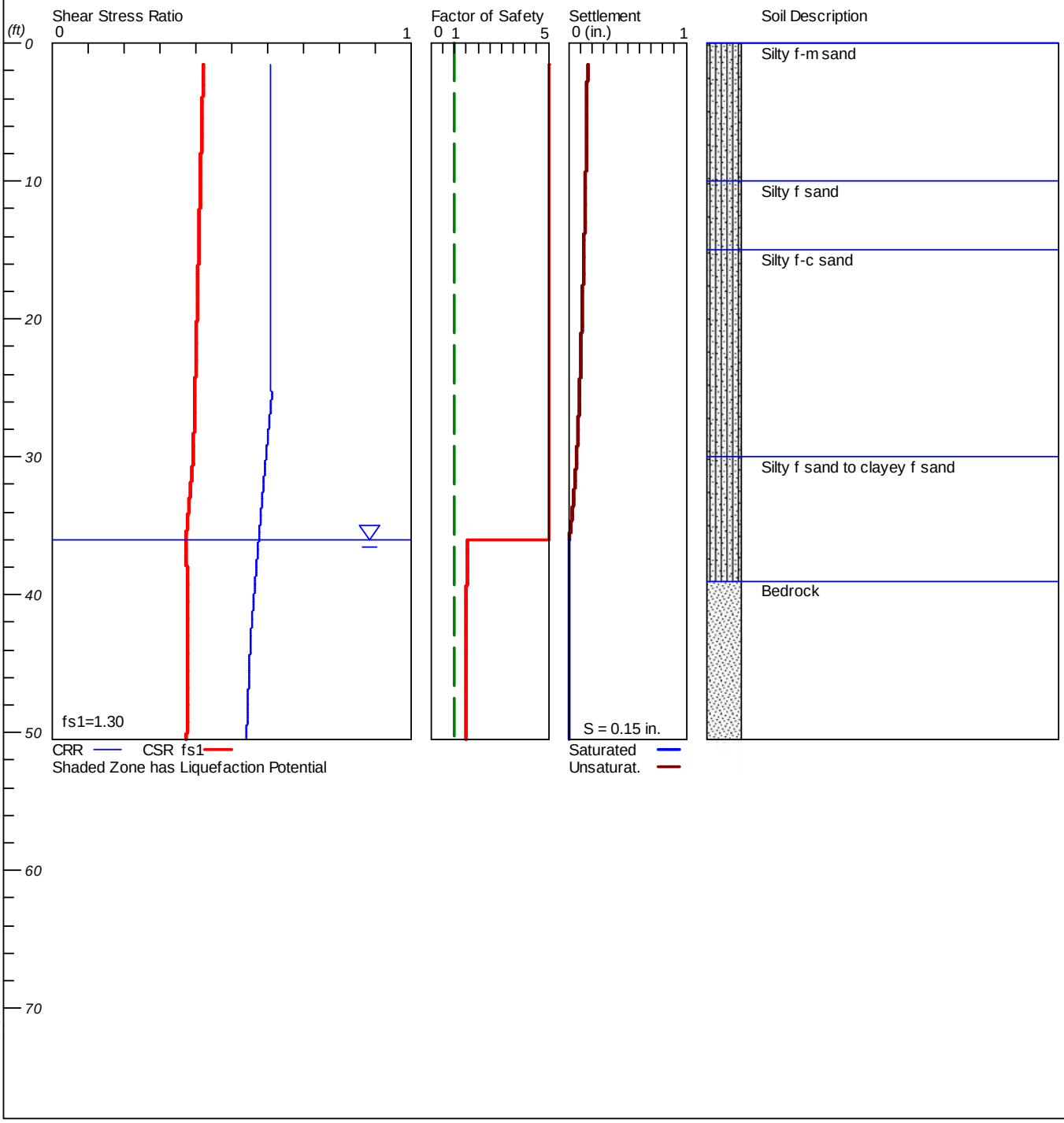
GEOTEK

LIQUEFACTION ANALYSIS

Proposed Warehouse

Hole No.=B-2 Water Depth=36 ft

Magnitude=6.94
Acceleration=0.5g



GeoTek

Perris, Riverside County, California

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LIQUEFACTION ANALYSIS SUMMARY

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Input File Name: G:\Projects\2151 to 2200\2156CR KSP Studio Warehouse Development 24 Malbert Road Perris\Geotechnical and Infiltration Evaluation\Liquefaction\2156CR B-2.liq
Title: Proposed Warehouse
Subtitle: Perris, Riverside County, California

Surface Elev.=
Hole No.=B-2
Depth of Hole= 50.50 ft
Water Table during Earthquake= 36.00 ft
Water Table during In-Situ Testing= 43.00 ft
Max. Acceleration= 0.5 g
Earthquake Magnitude= 6.94

Input Data:
Surface Elev.=
Hole No.=B-2
Depth of Hole=50.50 ft
Water Table during Earthquake= 36.00 ft
Water Table during In-Situ Testing= 43.00 ft
Max. Acceleration=0.5 g
Earthquake Magnitude=6.94
No-Liquefiable Soils: CL, OL are Non-Liq. Soil

1. SPT or BPT Calculation.
2. Settlement Analysis Method: Ishihara / Yoshimine
3. Fines Correction for Liquefaction: Idriss/Seed
4. Fine Correction for Settlement: During Liquefaction*
5. Settlement Calculation in: All zones*
6. Hammer Energy Ratio, Ce = 1.25
7. Borehole Diameter, Cb= 1
8. Sampling Method, Cs= 1.3
9. User request factor of safety (apply to CSR) , User= 1.3
   Plot one CSR curve (fs1=User)
10. Use Curve Smoothing: Yes*

* Recommended Options

In-Situ Test Data:

Depth ft	SPT	gamma pcf	Fines %
1.50	45.00	130.00	20.00
3.00	56.00	130.00	20.00
5.50	49.00	130.00	20.00
8.00	57.00	130.00	20.00
10.50	47.00	125.00	30.50
12.50	36.00	125.00	30.50
15.50	63.00	130.00	18.00
20.00	62.00	130.00	18.00
25.00	65.00	130.00	18.00
30.50	32.00	125.00	33.50
35.50	23.00	125.00	33.50
40.00	100.00	132.00	5.00
45.00	100.00	132.00	5.00
50.00	100.00	132.00	5.00

Output Results:

Settlement of Saturated Sands=0.00 in.
Settlement of Unsaturated Sands=0.15 in.
Total Settlement of Saturated and Unsaturated Sands=0.15 in.
Differential Settlement=0.077 to 0.102 in.

Depth ft	CRRm	CSRfs	F.S.	S_sat. in.	S_dry in.	S_all in.
1.50	0.61	0.42	5.00	0.00	0.15	0.15
2.50	0.61	0.42	5.00	0.00	0.15	0.15
3.50	0.61	0.42	5.00	0.00	0.15	0.15
4.50	0.61	0.42	5.00	0.00	0.15	0.15
5.50	0.61	0.42	5.00	0.00	0.15	0.15
6.50	0.61	0.42	5.00	0.00	0.15	0.15
7.50	0.61	0.42	5.00	0.00	0.14	0.14
8.50	0.61	0.41	5.00	0.00	0.14	0.14
9.50	0.61	0.41	5.00	0.00	0.14	0.14
10.50	0.61	0.41	5.00	0.00	0.14	0.14
11.50	0.61	0.41	5.00	0.00	0.14	0.14
12.50	0.61	0.41	5.00	0.00	0.13	0.13
13.50	0.61	0.41	5.00	0.00	0.13	0.13
14.50	0.61	0.41	5.00	0.00	0.13	0.13
15.50	0.61	0.41	5.00	0.00	0.12	0.12
16.50	0.61	0.41	5.00	0.00	0.12	0.12
17.50	0.61	0.41	5.00	0.00	0.12	0.12

18.50	0.61	0.40	5.00	0.00	0.11	0.11
19.50	0.61	0.40	5.00	0.00	0.11	0.11
20.50	0.61	0.40	5.00	0.00	0.11	0.11
21.50	0.61	0.40	5.00	0.00	0.10	0.10
22.50	0.61	0.40	5.00	0.00	0.10	0.10
23.50	0.61	0.40	5.00	0.00	0.10	0.10
24.50	0.61	0.40	5.00	0.00	0.09	0.09
25.50	0.61	0.40	5.00	0.00	0.09	0.09
26.50	0.61	0.40	5.00	0.00	0.08	0.08
27.50	0.60	0.40	5.00	0.00	0.08	0.08
28.50	0.60	0.39	5.00	0.00	0.07	0.07
29.50	0.60	0.39	5.00	0.00	0.07	0.07
30.50	0.59	0.39	5.00	0.00	0.06	0.06
31.50	0.59	0.39	5.00	0.00	0.05	0.05
32.50	0.59	0.38	5.00	0.00	0.04	0.04
33.50	0.58	0.38	5.00	0.00	0.03	0.03
34.50	0.58	0.38	5.00	0.00	0.02	0.02
35.50	0.58	0.37	5.00	0.00	0.01	0.01
36.50	0.57	0.37	1.54	0.00	0.00	0.00
37.50	0.57	0.37	1.53	0.00	0.00	0.00
38.50	0.57	0.38	1.51	0.00	0.00	0.00
39.50	0.56	0.38	1.50	0.00	0.00	0.00
40.50	0.56	0.38	1.49	0.00	0.00	0.00
41.50	0.56	0.38	1.48	0.00	0.00	0.00
42.50	0.55	0.38	1.47	0.00	0.00	0.00
43.50	0.55	0.38	1.46	0.00	0.00	0.00
44.50	0.55	0.38	1.46	0.00	0.00	0.00
45.50	0.55	0.38	1.45	0.00	0.00	0.00
46.50	0.55	0.38	1.45	0.00	0.00	0.00
47.50	0.55	0.38	1.45	0.00	0.00	0.00
48.50	0.54	0.38	1.45	0.00	0.00	0.00
49.50	0.54	0.38	1.45	0.00	0.00	0.00
50.50	0.54	0.37	1.45	0.00	0.00	0.00

* F.S.<1, Liquefaction Potential Zone
(F.S. is limited to 5, CRR is limited to 2, CSR is limited to 2)

Units: Unit: qc, fs, Stress or Pressure = atm (1.0581tsf); Unit Weight = pcf; Depth = ft; Settlement = in.

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1 atm (atmosphere) = 1 tsf (ton/ft2)
CRRm Cyclic resistance ratio from soils
CSRsf Cyclic stress ratio induced by a given earthquake (with user request factor of safety)
F.S. Factor of Safety against liquefaction, F.S.=CRRm/CSRsf
S_sat Settlement from saturated sands
S_dry Settlement from Unsaturated Sands

S_all	Total Settlement from Saturated and Unsaturated Sands
NoLiq	No-Liquefy Soils

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LIQUEFACTION ANALYSIS CALCULATION DETAILS

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Input File Name: G:\Projects\2151 to 2200\2156CR KSP Studio Warehouse Development 24 Malbert Road Perris\Geotechnical and Infiltration Evaluation\Liquefaction\2156CR B-2.liq
Title: Proposed Warehouse
Subtitle: Perris, Riverside County, California

Input Data:
Surface Elev.=
Hole No.=B-2
Depth of Hole=50.50 ft
Water Table during Earthquake= 36.00 ft
Water Table during In-Situ Testing= 43.00 ft
Max. Acceleration=0.5 g
Earthquake Magnitude=6.94
No-Liquefiable Soils: CL, OL are Non-Liq. Soil
1. SPT or BPT Calculation.
2. Settlement Analysis Method: Ishihara / Yoshimine
3. Fines Correction for Liquefaction: Idriss/Seed
4. Fine Correction for Settlement: During Liquefaction*
5. Settlement Calculation in: All zones*
6. Hammer Energy Ratio, Ce = 1.25
7. Borehole Diameter, Cb= 1
8. Sampling Method, Cs= 1.3
9. User request factor of safety (apply to CSR) , User= 1.3
   Plot one CSR curve (fs1=User)
10. Average two input data between two Depths: Yes*
* Recommended Options

In-Situ Test Data:

Depth ft	SPT	Gamma pcf	Fines %
1.50	45.00	130.00	20.00
3.00	56.00	130.00	20.00
5.50	49.00	130.00	20.00

8.00	57.00	130.00	20.00
10.50	47.00	125.00	30.50
12.50	36.00	125.00	30.50
15.50	63.00	130.00	18.00
20.00	62.00	130.00	18.00
25.00	65.00	130.00	18.00
30.50	32.00	125.00	33.50
35.50	23.00	125.00	33.50
40.00	100.00	132.00	5.00
45.00	100.00	132.00	5.00
50.00	100.00	132.00	5.00

Output Results:

Calculation segment, dz=0.050 ft

User defined Print Interval, dp=1.00 ft

Peak Ground Acceleration (PGA), a_max = 0.50g

CSR Calculation:

Depth	gamma	sigma	gamma'	sigma'	rd	mZ	a(z)	CSR	x fs1	=CSRfs
ft	pcf	atm	pcf	atm		g	g			
1.50	130.00	0.092	130.00	0.092	1.00	0.000	0.500	0.32	1.30	0.42
2.50	130.00	0.154	130.00	0.154	0.99	0.000	0.500	0.32	1.30	0.42
3.50	130.00	0.215	130.00	0.215	0.99	0.000	0.500	0.32	1.30	0.42
4.50	130.00	0.276	130.00	0.276	0.99	0.000	0.500	0.32	1.30	0.42
5.50	130.00	0.338	130.00	0.338	0.99	0.000	0.500	0.32	1.30	0.42
6.50	130.00	0.399	130.00	0.399	0.98	0.000	0.500	0.32	1.30	0.42
7.50	130.00	0.461	130.00	0.461	0.98	0.000	0.500	0.32	1.30	0.42
8.50	129.00	0.522	129.00	0.522	0.98	0.000	0.500	0.32	1.30	0.41
9.50	127.00	0.583	127.00	0.583	0.98	0.000	0.500	0.32	1.30	0.41
10.50	125.00	0.642	125.00	0.642	0.98	0.000	0.500	0.32	1.30	0.41
11.50	125.00	0.701	125.00	0.701	0.97	0.000	0.500	0.32	1.30	

0.41									
	12.50	125.00	0.760	125.00	0.760	0.97	0.000	0.500	0.32	1.30
0.41									
	13.50	126.67	0.820	126.67	0.820	0.97	0.000	0.500	0.31	1.30
0.41									
	14.50	128.33	0.880	128.33	0.880	0.97	0.000	0.500	0.31	1.30
0.41									
	15.50	130.00	0.941	130.00	0.941	0.96	0.000	0.500	0.31	1.30
0.41									
	16.50	130.00	1.002	130.00	1.002	0.96	0.000	0.500	0.31	1.30
0.41									
	17.50	130.00	1.064	130.00	1.064	0.96	0.000	0.500	0.31	1.30
0.41									
	18.50	130.00	1.125	130.00	1.125	0.96	0.000	0.500	0.31	1.30
0.40									
	19.50	130.00	1.187	130.00	1.187	0.95	0.000	0.500	0.31	1.30
0.40									
	20.50	130.00	1.248	130.00	1.248	0.95	0.000	0.500	0.31	1.30
0.40									
	21.50	130.00	1.310	130.00	1.310	0.95	0.000	0.500	0.31	1.30
0.40									
	22.50	130.00	1.371	130.00	1.371	0.95	0.000	0.500	0.31	1.30
0.40									
	23.50	130.00	1.432	130.00	1.432	0.95	0.000	0.500	0.31	1.30
0.40									
	24.50	130.00	1.494	130.00	1.494	0.94	0.000	0.500	0.31	1.30
0.40									
	25.50	129.55	1.555	129.55	1.555	0.94	0.000	0.500	0.31	1.30
0.40									
	26.50	128.64	1.616	128.64	1.616	0.94	0.000	0.500	0.30	1.30
0.40									
	27.50	127.73	1.677	127.73	1.677	0.94	0.000	0.500	0.30	1.30
0.40									
	28.50	126.82	1.737	126.82	1.737	0.93	0.000	0.500	0.30	1.30
0.39									
	29.50	125.91	1.797	125.91	1.797	0.93	0.000	0.500	0.30	1.30
0.39									
	30.50	125.00	1.856	125.00	1.856	0.93	0.000	0.500	0.30	1.30
0.39									
	31.50	125.00	1.915	125.00	1.915	0.92	0.000	0.500	0.30	1.30
0.39									
	32.50	125.00	1.974	125.00	1.974	0.91	0.000	0.500	0.30	1.30
0.38									
	33.50	125.00	2.033	125.00	2.033	0.90	0.000	0.500	0.29	1.30
0.38									
	34.50	125.00	2.092	125.00	2.092	0.89	0.000	0.500	0.29	1.30
0.38									
	35.50	125.00	2.151	125.00	2.151	0.89	0.000	0.500	0.29	1.30

0.37										
	36.50	126.56	2.211	64.16	2.197	0.88	0.000	0.500	0.29	1.30
0.37										
	37.50	128.11	2.271	65.71	2.228	0.87	0.000	0.500	0.29	1.30
0.37										
	38.50	129.67	2.332	67.27	2.260	0.86	0.000	0.500	0.29	1.30
0.38										
	39.50	131.22	2.393	68.82	2.292	0.85	0.000	0.500	0.29	1.30
0.38										
	40.50	132.00	2.456	69.60	2.324	0.84	0.000	0.500	0.29	1.30
0.38										
	41.50	132.00	2.518	69.60	2.357	0.84	0.000	0.500	0.29	1.30
0.38										
	42.50	132.00	2.580	69.60	2.390	0.83	0.000	0.500	0.29	1.30
0.38										
	43.50	132.00	2.643	69.60	2.423	0.82	0.000	0.500	0.29	1.30
0.38										
	44.50	132.00	2.705	69.60	2.456	0.81	0.000	0.500	0.29	1.30
0.38										
	45.50	132.00	2.768	69.60	2.489	0.80	0.000	0.500	0.29	1.30
0.38										
	46.50	132.00	2.830	69.60	2.522	0.80	0.000	0.500	0.29	1.30
0.38										
	47.50	132.00	2.892	69.60	2.555	0.79	0.000	0.500	0.29	1.30
0.38										
	48.50	132.00	2.955	69.60	2.588	0.78	0.000	0.500	0.29	1.30
0.38										
	49.50	132.00	3.017	69.60	2.620	0.77	0.000	0.500	0.29	1.30
0.38										
	50.50	132.00	3.079	69.60	2.653	0.76	0.000	0.500	0.29	1.30
0.37										

CSR is based on water table at 36.00 during earthquake

CRR Calculation from SPT or BPT data:

Depth	SPT	Cebs	Cr	sigma'	Cn	(N1)60	Fines	d(N1)60	(N1)60f	CRR7.5
ft				atm			%			
1.50	45.00	1.63	0.75	0.092	1.70	93.23	20.00	11.02	104.26	0.50
2.50	52.33	1.63	0.75	0.154	1.70	108.43	20.00	12.23	120.66	0.50
3.50	54.60	1.63	0.75	0.215	1.70	113.12	20.00	12.60		

125.73	0.50								
	4.50	51.80	1.63	0.75	0.276	1.70	107.32	20.00	12.14
119.46	0.50								
	5.50	49.00	1.63	0.75	0.338	1.70	101.52	20.00	11.68
113.20	0.50								
	6.50	52.20	1.63	0.75	0.399	1.58	100.68	20.00	11.61
112.29	0.50								
	7.50	55.40	1.63	0.75	0.461	1.47	99.47	20.00	11.52
110.99	0.50								
	8.50	55.00	1.63	0.85	0.522	1.38	105.14	22.10	13.81
118.95	0.50								
	9.50	51.00	1.63	0.85	0.583	1.31	92.29	26.30	15.94
108.23	0.50								
	10.50	47.00	1.63	0.85	0.642	1.25	81.01	30.50	17.57
98.59	0.50								
	11.50	41.50	1.63	0.85	0.701	1.19	68.45	30.50	15.58
84.04	0.50								
	12.50	36.00	1.63	0.85	0.760	1.15	57.03	30.50	13.77
70.80	0.50								
	13.50	45.00	1.63	0.85	0.820	1.10	68.65	26.33	13.01
81.66	0.50								
	14.50	54.00	1.63	0.85	0.880	1.07	79.51	22.17	11.45
90.97	0.50								
	15.50	63.00	1.63	0.95	0.941	1.03	100.26	18.00	9.89
110.15	0.50								
	16.50	62.78	1.63	0.95	1.002	1.00	96.80	18.00	9.66
106.46	0.50								
	17.50	62.56	1.63	0.95	1.064	0.97	93.63	18.00	9.45
103.08	0.50								
	18.50	62.33	1.63	0.95	1.125	0.94	90.71	18.00	9.25
99.97	0.50								
	19.50	62.11	1.63	0.95	1.187	0.92	88.02	18.00	9.08
97.09	0.50								
	20.50	62.30	1.63	0.95	1.248	0.90	86.09	18.00	8.95
95.03	0.50								
	21.50	62.90	1.63	0.95	1.310	0.87	84.85	18.00	8.87
93.72	0.50								
	22.50	63.50	1.63	0.95	1.371	0.85	83.72	18.00	8.79
92.51	0.50								
	23.50	64.10	1.63	0.95	1.432	0.84	82.68	18.00	8.72
91.40	0.50								
	24.50	64.70	1.63	0.95	1.494	0.82	81.72	18.00	8.66
90.38	0.50								
	25.50	62.00	1.63	0.95	1.555	0.80	76.75	19.41	9.31
86.05	0.50								
	26.50	56.00	1.63	0.95	1.616	0.79	68.00	22.23	10.40
78.40	0.50								
	27.50	50.00	1.63	0.95	1.677	0.77	59.61	25.05	11.17

70.78	0.50								
	28.50	44.00	1.63	1.00	1.737	0.76	54.25	27.86	11.99
66.24	0.50								
	29.50	38.00	1.63	1.00	1.797	0.75	46.07	30.68	12.12
58.19	0.50								
	30.50	32.00	1.63	1.00	1.856	0.73	38.17	33.50	11.93
50.10	0.50								
	31.50	30.20	1.63	1.00	1.915	0.72	35.46	33.50	11.43
46.89	0.50								
	32.50	28.40	1.63	1.00	1.974	0.71	32.85	33.50	10.95
43.79	0.50								
	33.50	26.60	1.63	1.00	2.033	0.70	30.31	33.50	10.48
40.80	0.50								
	34.50	24.80	1.63	1.00	2.092	0.69	27.86	33.50	10.03
37.89	0.50								
	35.50	23.00	1.63	1.00	2.151	0.68	25.48	33.50	9.59
35.08	0.50								
	36.50	40.11	1.63	1.00	2.211	0.67	43.83	27.17	10.26
54.10	0.50								
	37.50	57.22	1.63	1.00	2.271	0.66	61.70	20.84	9.00
70.70	0.50								
	38.50	74.33	1.63	1.00	2.332	0.65	79.10	14.50	5.93
85.03	0.50								
	39.50	91.44	1.63	1.00	2.393	0.65	96.05	8.17	1.62
97.66	0.50								
	40.50	100.00	1.63	1.00	2.456	0.64	103.70	5.00	0.00
103.70	0.50								
	41.50	100.00	1.63	1.00	2.518	0.63	102.41	5.00	0.00
102.41	0.50								
	42.50	100.00	1.63	1.00	2.580	0.62	101.16	5.00	0.00
101.16	0.50								
	43.50	100.00	1.63	1.00	2.630	0.62	100.21	5.00	0.00
100.21	0.50								
	44.50	100.00	1.63	1.00	2.662	0.61	99.59	5.00	0.00
99.59	0.50								
	45.50	100.00	1.63	1.00	2.695	0.61	98.98	5.00	0.00
98.98	0.50								
	46.50	100.00	1.63	1.00	2.728	0.61	98.38	5.00	0.00
98.38	0.50								
	47.50	100.00	1.63	1.00	2.761	0.60	97.79	5.00	0.00
97.79	0.50								
	48.50	100.00	1.63	1.00	2.794	0.60	97.22	5.00	0.00
97.22	0.50								
	49.50	100.00	1.63	1.00	2.827	0.59	96.65	5.00	0.00
96.65	0.50								
	50.50	100.00	1.63	1.00	2.860	0.59	96.09	5.00	0.00
96.09	0.50								

CRR is based on water table at 43.00 during In-Situ Testing

Factor of Safety, - Earthquake Magnitude= 6.94:

Depth ft	sigC' atm	CRR7.5	x Ksig	=CRRv	x MSF	=CRRm	CSRfs	F.S.=CRRm/CSRfs
1.50	0.06	0.50	1.00	0.50	1.22	0.61	0.42	5.00
2.50	0.10	0.50	1.00	0.50	1.22	0.61	0.42	5.00
3.50	0.14	0.50	1.00	0.50	1.22	0.61	0.42	5.00
4.50	0.18	0.50	1.00	0.50	1.22	0.61	0.42	5.00
5.50	0.22	0.50	1.00	0.50	1.22	0.61	0.42	5.00
6.50	0.26	0.50	1.00	0.50	1.22	0.61	0.42	5.00
7.50	0.30	0.50	1.00	0.50	1.22	0.61	0.42	5.00
8.50	0.34	0.50	1.00	0.50	1.22	0.61	0.41	5.00
9.50	0.38	0.50	1.00	0.50	1.22	0.61	0.41	5.00
10.50	0.42	0.50	1.00	0.50	1.22	0.61	0.41	5.00
11.50	0.46	0.50	1.00	0.50	1.22	0.61	0.41	5.00
12.50	0.49	0.50	1.00	0.50	1.22	0.61	0.41	5.00
13.50	0.53	0.50	1.00	0.50	1.22	0.61	0.41	5.00
14.50	0.57	0.50	1.00	0.50	1.22	0.61	0.41	5.00
15.50	0.61	0.50	1.00	0.50	1.22	0.61	0.41	5.00
16.50	0.65	0.50	1.00	0.50	1.22	0.61	0.41	5.00
17.50	0.69	0.50	1.00	0.50	1.22	0.61	0.41	5.00
18.50	0.73	0.50	1.00	0.50	1.22	0.61	0.40	5.00
19.50	0.77	0.50	1.00	0.50	1.22	0.61	0.40	5.00
20.50	0.81	0.50	1.00	0.50	1.22	0.61	0.40	5.00
21.50	0.85	0.50	1.00	0.50	1.22	0.61	0.40	5.00
22.50	0.89	0.50	1.00	0.50	1.22	0.61	0.40	5.00
23.50	0.93	0.50	1.00	0.50	1.22	0.61	0.40	5.00
24.50	0.97	0.50	1.00	0.50	1.22	0.61	0.40	5.00
25.50	1.01	0.50	1.00	0.50	1.22	0.61	0.40	5.00
26.50	1.05	0.50	1.00	0.50	1.22	0.61	0.40	5.00
27.50	1.09	0.50	0.99	0.50	1.22	0.60	0.40	5.00
28.50	1.13	0.50	0.99	0.49	1.22	0.60	0.39	5.00
29.50	1.17	0.50	0.98	0.49	1.22	0.60	0.39	5.00
30.50	1.21	0.50	0.97	0.49	1.22	0.59	0.39	5.00
31.50	1.24	0.50	0.97	0.48	1.22	0.59	0.39	5.00
32.50	1.28	0.50	0.96	0.48	1.22	0.59	0.38	5.00
33.50	1.32	0.50	0.96	0.48	1.22	0.58	0.38	5.00
34.50	1.36	0.50	0.95	0.48	1.22	0.58	0.38	5.00
35.50	1.40	0.50	0.95	0.47	1.22	0.58	0.37	5.00
36.50	1.44	0.50	0.94	0.47	1.22	0.57	0.37	1.54
37.50	1.48	0.50	0.94	0.47	1.22	0.57	0.37	1.53
38.50	1.52	0.50	0.93	0.47	1.22	0.57	0.38	1.51
39.50	1.56	0.50	0.93	0.46	1.22	0.56	0.38	1.50

40.50	1.60	0.50	0.92	0.46	1.22	0.56	0.38	1.49
41.50	1.64	0.50	0.91	0.46	1.22	0.56	0.38	1.48
42.50	1.68	0.50	0.91	0.45	1.22	0.55	0.38	1.47
43.50	1.71	0.50	0.91	0.45	1.22	0.55	0.38	1.46
44.50	1.73	0.50	0.90	0.45	1.22	0.55	0.38	1.46
45.50	1.75	0.50	0.90	0.45	1.22	0.55	0.38	1.45
46.50	1.77	0.50	0.90	0.45	1.22	0.55	0.38	1.45
47.50	1.79	0.50	0.90	0.45	1.22	0.55	0.38	1.45
48.50	1.82	0.50	0.89	0.45	1.22	0.54	0.38	1.45
49.50	1.84	0.50	0.89	0.45	1.22	0.54	0.38	1.45
50.50	1.86	0.50	0.89	0.44	1.22	0.54	0.37	1.45

* F.S.<1: Liquefaction Potential Zone. (If above water table: F.S.=5)
^ No-liquefiable Soils or above Water Table.
(F.S. is limited to 5, CRR is limited to 2, CSR is limited to 2)

CPT convert to SPT for Settlement Analysis:
Fines Correction for Settlement Analysis:

Depth ft	Ic	qc/N60	qc1 atm	(N1)60	Fines %	d(N1)60	(N1)60s
1.50	-	-	-	100.00	20.00	0.00	100.00
2.50	-	-	-	100.00	20.00	0.00	100.00
3.50	-	-	-	100.00	20.00	0.00	100.00
4.50	-	-	-	100.00	20.00	0.00	100.00
5.50	-	-	-	100.00	20.00	0.00	100.00
6.50	-	-	-	100.00	20.00	0.00	100.00
7.50	-	-	-	100.00	20.00	0.00	100.00
8.50	-	-	-	100.00	22.10	0.00	100.00
9.50	-	-	-	100.00	26.30	0.00	100.00
10.50	-	-	-	98.59	30.50	0.00	98.59
11.50	-	-	-	84.04	30.50	0.00	84.04
12.50	-	-	-	70.80	30.50	0.00	70.80
13.50	-	-	-	81.66	26.33	0.00	81.66
14.50	-	-	-	90.97	22.17	0.00	90.97
15.50	-	-	-	100.00	18.00	0.00	100.00
16.50	-	-	-	100.00	18.00	0.00	100.00
17.50	-	-	-	100.00	18.00	0.00	100.00
18.50	-	-	-	99.97	18.00	0.00	99.97
19.50	-	-	-	97.09	18.00	0.00	97.09
20.50	-	-	-	95.03	18.00	0.00	95.03
21.50	-	-	-	93.72	18.00	0.00	93.72
22.50	-	-	-	92.51	18.00	0.00	92.51
23.50	-	-	-	91.40	18.00	0.00	91.40
24.50	-	-	-	90.38	18.00	0.00	90.38
25.50	-	-	-	86.05	19.41	0.00	86.05
26.50	-	-	-	78.40	22.23	0.00	78.40

27.50	-	-	-	70.78	25.05	0.00	70.78
28.50	-	-	-	66.24	27.86	0.00	66.24
29.50	-	-	-	58.19	30.68	0.00	58.19
30.50	-	-	-	50.10	33.50	0.00	50.10
31.50	-	-	-	46.89	33.50	0.00	46.89
32.50	-	-	-	43.79	33.50	0.00	43.79
33.50	-	-	-	40.80	33.50	0.00	40.80
34.50	-	-	-	37.89	33.50	0.00	37.89
35.50	-	-	-	35.08	33.50	0.00	35.08
36.50	-	-	-	54.10	27.17	0.00	54.10
37.50	-	-	-	70.70	20.84	0.00	70.70
38.50	-	-	-	85.03	14.50	0.00	85.03
39.50	-	-	-	97.66	8.17	0.00	97.66
40.50	-	-	-	100.00	5.00	0.00	100.00
41.50	-	-	-	100.00	5.00	0.00	100.00
42.50	-	-	-	100.00	5.00	0.00	100.00
43.50	-	-	-	100.00	5.00	0.00	100.00
44.50	-	-	-	99.59	5.00	0.00	99.59
45.50	-	-	-	98.98	5.00	0.00	98.98
46.50	-	-	-	98.38	5.00	0.00	98.38
47.50	-	-	-	97.79	5.00	0.00	97.79
48.50	-	-	-	97.22	5.00	0.00	97.22
49.50	-	-	-	96.65	5.00	0.00	96.65
50.50	-	-	-	96.09	5.00	0.00	96.09

(N1)60s has been fines corrected in liquefaction analysis, therefore d(N1)60=0.
Fines=NoLiq means the soils are not liquefiable.

Settlement of Saturated Sands:
Settlement Analysis Method: Ishihara / Yoshimine

Depth ft	CSRsf	/ MSF*	=CSRm	F.S.	Fines %	(N1)60s	Dr %	ec %	dsz in.	dsp in.	S in.
50.45	0.37	1.00	0.37	1.45	5.00	96.12	100.00	0.000	0.0E0	0.000	0.000
49.50	0.38	1.00	0.38	1.45	5.00	96.65	100.00	0.000	0.0E0	0.000	0.000
48.50	0.38	1.00	0.38	1.45	5.00	97.22	100.00	0.000	0.0E0	0.000	0.000
47.50	0.38	1.00	0.38	1.45	5.00	97.79	100.00	0.000	0.0E0	0.000	0.000
46.50	0.38	1.00	0.38	1.45	5.00	98.38	100.00	0.000			

0.0E0 0.000 0.000
45.50 0.38 1.00 0.38 1.45 5.00 98.98 100.00 0.000
0.0E0 0.000 0.000
44.50 0.38 1.00 0.38 1.46 5.00 99.59 100.00 0.000
0.0E0 0.000 0.000
43.50 0.38 1.00 0.38 1.46 5.00 100.00 100.00 0.000
0.0E0 0.000 0.000
42.50 0.38 1.00 0.38 1.47 5.00 100.00 100.00 0.000
0.0E0 0.000 0.000
41.50 0.38 1.00 0.38 1.48 5.00 100.00 100.00 0.000
0.0E0 0.000 0.000
40.50 0.38 1.00 0.38 1.49 5.00 100.00 100.00 0.000
0.0E0 0.000 0.000
39.50 0.38 1.00 0.38 1.50 8.17 97.66 100.00 0.000
0.0E0 0.000 0.000
38.50 0.38 1.00 0.38 1.51 14.50 85.03 100.00 0.000
0.0E0 0.000 0.000
37.50 0.37 1.00 0.37 1.53 20.84 70.70 100.00 0.000
0.0E0 0.000 0.000
36.50 0.37 1.00 0.37 1.54 27.17 54.10 100.00 0.000
0.0E0 0.000 0.000
36.05 0.37 1.00 0.37 1.55 30.02 45.85 100.00 0.000
0.0E0 0.000 0.000
No Settlement of Saturated Sands

Settlement of Saturated Sands=0.000 in.
qc1 and (N1)60 is after fines correction in liquefaction analysis
dsz is per each segment, dz=0.05 ft
dsp is per each print interval, dp=1.00 ft
S is cumulated settlement at this depth

Settlement of Unsaturated Sands:

Depth	sigma'	sigC'	(N1)60s	CSRsf	Gmax	g*Ge/Gm	g_eff	ec7.5	Cec	ec	dsz	dsp	S
ft	atm	atm			atm			%		%	in.	in.	in.
36.00	2.18	1.42	44.90	0.37	1890.11	4.3E-4	0.1366	0.0432	0.91	0.0394	4.73E-4	0.000	0.000
35.50	2.15	1.40	35.08	0.37	1729.06	4.7E-4	0.1733	0.0752	0.91	0.0685	8.23E-4	0.006	0.006
34.50	2.09	1.36	37.89	0.38	1749.59	4.5E-4	0.1579	0.0576	0.91	0.0525	6.30E-4	0.014	0.021
33.50	2.03	1.32	40.80	0.38	1767.66	4.4E-4	0.1446	0.0457	0.91				

0.0417	5.00E-4	0.011	0.032							
	32.50	1.97	1.28	43.79	0.38	1783.40	4.3E-4	0.1330	0.0420	0.91
0.0383	4.60E-4	0.010	0.041							
	31.50	1.92	1.24	46.89	0.39	1796.95	4.1E-4	0.1227	0.0388	0.91
0.0354	4.24E-4	0.009	0.050							
	30.50	1.86	1.21	50.10	0.39	1808.41	4.0E-4	0.1136	0.0359	0.91
0.0327	3.93E-4	0.008	0.058							
	29.50	1.80	1.17	58.19	0.39	1870.24	3.8E-4	0.0974	0.0308	0.91
0.0281	3.37E-4	0.007	0.066							
	28.50	1.74	1.13	66.24	0.39	1919.99	3.6E-4	0.0847	0.0268	0.91
0.0244	2.93E-4	0.006	0.072							
	27.50	1.68	1.09	70.78	0.40	1928.54	3.4E-4	0.0778	0.0246	0.91
0.0224	2.69E-4	0.006	0.077							
	26.50	1.62	1.05	78.40	0.40	1959.02	3.3E-4	0.0696	0.0220	0.91
0.0201	2.41E-4	0.005	0.083							
	25.50	1.56	1.01	86.05	0.40	1982.20	3.1E-4	0.0628	0.0199	0.91
0.0181	2.17E-4	0.005	0.087							
	24.50	1.49	0.97	90.38	0.40	1974.65	3.0E-4	0.0586	0.0185	0.91
0.0169	2.03E-4	0.004	0.091							
	23.50	1.43	0.93	91.40	0.40	1940.89	2.9E-4	0.0560	0.0177	0.91
0.0161	1.94E-4	0.004	0.095							
	22.50	1.37	0.89	92.51	0.40	1906.47	2.9E-4	0.0535	0.0169	0.91
0.0154	1.85E-4	0.004	0.099							
	21.50	1.31	0.85	93.72	0.40	1871.32	2.8E-4	0.0510	0.0161	0.91
0.0147	1.76E-4	0.004	0.103							
	20.50	1.25	0.81	95.03	0.40	1835.41	2.7E-4	0.0485	0.0153	0.91
0.0140	1.68E-4	0.003	0.106							
	19.50	1.19	0.77	97.09	0.40	1802.50	2.7E-4	0.0459	0.0145	0.91
0.0132	1.59E-4	0.003	0.109							
	18.50	1.13	0.73	99.97	0.40	1772.35	2.6E-4	0.0561	0.0177	0.91
0.0162	1.94E-4	0.004	0.113							
	17.50	1.06	0.69	100.00	0.41	1723.48	2.5E-4	0.0526	0.0166	0.91
0.0152	1.82E-4	0.004	0.117							
	16.50	1.00	0.65	100.00	0.41	1672.97	2.4E-4	0.0493	0.0156	0.91
0.0142	1.70E-4	0.004	0.120							
	15.50	0.94	0.61	100.00	0.41	1620.90	2.4E-4	0.0461	0.0146	0.91
0.0133	1.59E-4	0.003	0.123							
	14.50	0.88	0.57	90.97	0.41	1518.81	2.4E-4	0.0462	0.0146	0.91
0.0133	1.60E-4	0.003	0.127							
	13.50	0.82	0.53	81.66	0.41	1414.18	2.4E-4	0.0465	0.0147	0.91
0.0134	1.61E-4	0.003	0.130							
	12.50	0.76	0.49	70.80	0.41	1298.74	2.4E-4	0.0478	0.0151	0.91
0.0138	1.65E-4	0.003	0.133							
	11.50	0.70	0.46	84.04	0.41	1320.52	2.2E-4	0.0390	0.0123	0.91
0.0112	1.35E-4	0.003	0.136							
	10.50	0.64	0.42	98.59	0.41	1332.68	2.0E-4	0.0328	0.0104	0.91
0.0094	1.13E-4	0.002	0.138							
	9.50	0.58	0.38	100.00	0.41	1275.39	1.9E-4	0.0301	0.0095	0.91

0.0087	1.04E-4	0.002	0.141								
	8.50	0.52	0.34	100.00	0.41	1207.34	1.8E-4	0.0337	0.0107	0.91	
0.0097	1.17E-4	0.002	0.143								
	7.50	0.46	0.30	100.00	0.42	1134.22	1.7E-4	0.0310	0.0098	0.91	
0.0089	1.07E-4	0.002	0.145								
	6.50	0.40	0.26	100.00	0.42	1055.90	1.6E-4	0.0282	0.0089	0.91	
0.0081	9.77E-5	0.002	0.147								
	5.50	0.34	0.22	100.00	0.42	971.28	1.5E-4	0.0254	0.0080	0.91	
0.0073	8.78E-5	0.002	0.149								
	4.50	0.28	0.18	100.00	0.42	878.56	1.3E-4	0.0224	0.0071	0.91	
0.0065	7.75E-5	0.002	0.150								
	3.50	0.22	0.14	100.00	0.42	774.82	1.2E-4	0.0248	0.0078	0.91	
0.0071	8.58E-5	0.002	0.152								
	2.50	0.15	0.10	100.00	0.42	654.84	9.9E-5	0.0195	0.0062	0.91	
0.0056	6.74E-5	0.002	0.154								
	1.50	0.09	0.06	100.00	0.42	507.24	7.6E-5	0.0131	0.0041	0.91	
0.0038	4.52E-5	0.001	0.155								

Settlement of Unsaturated Sands=0.155 in.
dsz is per each segment, dz=0.05 ft
dsp is per each print interval, dp=1.00 ft
S is cumulated settlement at this depth

Total Settlement of Saturated and Unsaturated Sands=0.155 in.
Differential Settlement=0.077 to 0.102 in.

Units: Unit: qc, fs, Stress or Pressure = atm (1.0581tsf); Unit Weight = pcf; Depth = ft; Settlement = in.

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1 atm (atmosphere) = 1.0581 tsf(1 tsf = 1 ton/ft2 = 2 kip/ft2)
1 atm (atmosphere) = 101.325 kPa(1 kPa = 1 kN/m2 = 0.001 Mpa)

SPT	Field data from Standard Penetration Test (SPT)
BPT	Field data from Becker Penetration Test (BPT)
qc	Field data from Cone Penetration Test (CPT) [atm (tsf)]
fs	Friction from CPT testing [atm (tsf)]
Rf	Ratio of fs/qc (%)
gamma	Total unit weight of soil
gamma'	Effective unit weight of soil
Fines	Fines content [%]
D50	Mean grain size
Dr	Relative Density
sigma	Total vertical stress [atm]
sigma'	Effective vertical stress [atm]
sigC'	Effective confining pressure [atm]

rd	Acceleration reduction coefficient by Seed
a_max.	Peak Ground Acceleration (PGA) in ground surface
mZ	Linear acceleration reduction coefficient X depth
a_min.	Minimum acceleration under linear reduction, mZ
CRRv	CRR after overburden stress correction, CRRv=CRR7.5 * Ksig
CRR7.5	Cyclic resistance ratio (M=7.5)
Ksig	Overburden stress correction factor for CRR7.5
CRRm	After magnitude scaling correction CRRm=CRRv * MSF
MSF	Magnitude scaling factor from M=7.5 to user input M
CSR	Cyclic stress ratio induced by earthquake
CSRfs	CSRfs=CSR*fs1 (Default fs1=1)
fs1	First CSR curve in graphic defined in #9 of Advanced page
fs2	2nd CSR curve in graphic defined in #9 of Advanced page
F.S.	Calculated factor of safety against liquefaction F.S.=CRRm/CSRsf
Cebs	Energy Ratio, Borehole Dia., and Sampling Method Corrections
Cr	Rod Length Corrections
Cn	Overburden Pressure Correction
(N1)60	SPT after corrections, (N1)60=SPT * Cr * Cn * Cebs
d(N1)60	Fines correction of SPT
(N1)60f	(N1)60 after fines corrections, (N1)60f=(N1)60 + d(N1)60
Cq	Overburden stress correction factor
qc1	CPT after Overburden stress correction
dqc1	Fines correction of CPT
qc1f	CPT after Fines and Overburden correction, qc1f=qc1 + dqc1
qc1n	CPT after normalization in Robertson's method
Kc	Fine correction factor in Robertson's Method
qc1f	CPT after Fines correction in Robertson's Method
Ic	Soil type index in Suzuki's and Robertson's Methods
(N1)60s	(N1)60 after settlement fines corrections
CSRm	After magnitude scaling correction for Settlement calculation CSRm=CSRsf / MSF*
CSRfs	Cyclic stress ratio induced by earthquake with user inputed fs
MSF*	Scaling factor from CSR, MSF*=1, based on Item 2 of Page C.
ec	Volumetric strain for saturated sands
dz	Calculation segment, dz=0.050 ft
dsz	Settlement in each segment, dz
dp	User defined print interval
dsp	Settlement in each print interval, dp
Gmax	Shear Modulus at low strain
g_eff	gamma_eff, Effective shear Strain
g*Ge/Gm	gamma_eff * G_eff/G_max, Strain-modulus ratio
ec7.5	Volumetric Strain for magnitude=7.5
Cec	Magnitude correction factor for any magnitude
ec	Volumetric strain for unsaturated sands, ec=Cec * ec7.5
NoLiq	No-Liquefy Soils

References:

1. NCEER Workshop on Evaluation of Liquefaction Resistance of Soils. Youd, T.L., and Idriss, I.M., eds., Technical Report NCEER 97-0022.

SP117. Southern California Earthquake Center. Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California. University of Southern California. March 1999.

2. RECENT ADVANCES IN SOIL LIQUEFACTION ENGINEERING AND SEISMIC SITE RESPONSE EVALUATION, Paper No. SPL-2, PROCEEDINGS: Fourth International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics, San Diego, CA, March 2001.

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Note: Print Interval you selected does not show complete results. To get complete results, you should select 'Segment' in Print Interval (Item 12, Page C).

APPENDIX D

GENERAL GRADING GUIDELINES

Proposed Warehouse Development
24 Malbert Street
Perris, Riverside County, California
Project No. 2156-CR

GEOTEK

GENERAL GRADING GUIDELINES

Guidelines presented herein are intended to address general construction procedures for earthwork construction. Specific situations and conditions often arise which cannot reasonably be discussed in general guidelines, when anticipated these are discussed in the text of the report. Often unanticipated conditions are encountered which may necessitate modification or changes to these guidelines. It is our hope that these will assist the contractor to more efficiently complete the project by providing a reasonable understanding of the procedures that would be expected during earthwork and the testing and observation used to evaluate those procedures.

General

Grading should be performed to at least the minimum requirements of governing agencies, Chapters 18 and 33 of the California Building Code, CBC (2016) and the guidelines presented below.

Preconstruction Meeting

A preconstruction meeting should be held prior to site earthwork. Any questions the contractor has regarding our recommendations, general site conditions, apparent discrepancies between reported and actual conditions and/or differences in procedures the contractor intends to use should be brought up at that meeting. The contractor (including the main onsite representative) should review our report and these guidelines in advance of the meeting. Any comments the contractor may have regarding these guidelines should be brought up at that meeting.

Grading Observation and Testing

1. Observation of the fill placement should be provided by our representative during grading. Verbal communication during the course of each day will be used to inform the contractor of test results. The contractor should receive a copy of the "Daily Field Report" indicating results of field density tests that day. If our representative does not provide the contractor with these reports, our office should be notified.
2. Testing and observation procedures are, by their nature, specific to the work or area observed and location of the tests taken, variability may occur in other locations. The contractor is responsible for the uniformity of the grading operations; our observations and test results are intended to evaluate the contractor's overall level of efforts during grading. The contractor's personnel are the only individuals participating in all aspect of site work. Compaction testing and observation should not be considered as relieving the contractor's responsibility to properly compact the fill.
3. Cleanouts, processed ground to receive fill, key excavations, and subdrains should be observed by our representative prior to placing any fill. It will be the contractor's responsibility to notify our representative or office when such areas are ready for observation.
4. Density tests may be made on the surface material to receive fill, as considered warranted by this firm.
5. In general, density tests would be made at maximum intervals of two feet of fill height or every 1,000 cubic yards of fill placed. Criteria will vary depending on soil conditions and size of the fill. More frequent testing may be performed. In any case, an adequate number of field density tests should be made to evaluate the required compaction and moisture content is generally being obtained.

6. Laboratory testing to support field test procedures will be performed, as considered warranted, based on conditions encountered (e.g. change of material sources, types, etc.) Every effort will be made to process samples in the laboratory as quickly as possible and in progress construction projects are our first priority. However, laboratory workloads may cause in delays and some soils may require a **minimum of 48 to 72 hours to complete test procedures**. Whenever possible, our representative(s) should be informed in advance of operational changes that might result in different source areas for materials.
7. Procedures for testing of fill slopes are as follows:
   a) Density tests should be taken periodically during grading on the flat surface of the fill, three to five feet horizontally from the face of the slope.
   b) If a method other than over building and cutting back to the compacted core is to be employed, slope compaction testing during construction should include testing the outer six inches to three feet in the slope face to determine if the required compaction is being achieved.
8. Finish grade testing of slopes and pad surfaces should be performed after construction is complete.

Site Clearing

1. All vegetation, and other deleterious materials, should be removed from the site. If material is not immediately removed from the site it should be stockpiled in a designated area(s) well outside of all current work areas and delineated with flagging or other means. Site clearing should be performed in advance of any grading in a specific area.
2. Efforts should be made by the contractor to remove all organic or other deleterious material from the fill, as even the most diligent efforts may result in the incorporation of some materials. This is especially important when grading is occurring near the natural grade. All equipment operators should be aware of these efforts. Laborers may be required as root pickers.
3. Nonorganic debris or concrete may be placed in deeper fill areas provided the procedures used are observed and found acceptable by our representative.

Treatment of Existing Ground

1. Following site clearing, all surficial deposits of alluvium and colluvium as well as weathered or creep effected bedrock, should be removed unless otherwise specifically indicated in the text of this report.
2. In some cases, removal may be recommended to a specified depth (e.g. flat sites where partial alluvial removals may be sufficient). The contractor should not exceed these depths unless directed otherwise by our representative.
3. Groundwater existing in alluvial areas may make excavation difficult. Deeper removals than indicated in the text of the report may be necessary due to saturation during winter months.
4. Subsequent to removals, the natural ground should be processed to a depth of six inches, moistened to near optimum moisture conditions and compacted to fill standards.
5. Exploratory back hoe or dozer trenches still remaining after site removal should be excavated and filled with compacted fill if they can be located.

Fill Placement

1. Unless otherwise indicated, all site soil and bedrock may be reused for compacted fill; however, some special processing or handling may be required (see text of report).

2. Material used in the compacting process should be evenly spread, moisture conditioned, processed, and compacted in thin lifts six (6) to eight (8) inches in compacted thickness to obtain a uniformly dense layer. The fill should be placed and compacted on a nearly horizontal plane, unless otherwise found acceptable by our representative.
3. If the moisture content or relative density varies from that recommended by this firm, the contractor should rework the fill until it is in accordance with the following:
   a) Moisture content of the fill should be at or above optimum moisture. Moisture should be evenly distributed without wet and dry pockets. Pre-watering of cut or removal areas should be considered in addition to watering during fill placement, particularly in clay or dry surficial soils. The ability of the contractor to obtain the proper moisture content will control production rates.
   b) Each six-inch layer should be compacted to at least 90 percent of the maximum dry density in compliance with the testing method specified by the controlling governmental agency. In most cases, the testing method is ASTM Test Designation D 1557.
4. Rock fragments less than eight inches in diameter may be utilized in the fill, provided:
   a) They are not placed in concentrated pockets;
   b) There is a sufficient percentage of fine-grained material to surround the rocks;
   c) The distribution of the rocks is observed by, and acceptable to, our representative.
5. Rocks exceeding eight (8) inches in diameter should be taken off site, broken into smaller fragments, or placed in accordance with recommendations of this firm in areas designated suitable for rock disposal. On projects where significant large quantities of oversized materials are anticipated, alternate guidelines for placement may be included. If significant oversize materials are encountered during construction, these guidelines should be requested.
6. In clay soil, dry or large chunks or blocks are common. If in excess of eight (8) inches minimum dimension, then they are considered as oversized. Sheepsfoot compactors or other suitable methods should be used to break up blocks. When dry, they should be moisture conditioned to provide a uniform condition with the surrounding fill.

Slope Construction

1. The contractor should obtain a minimum relative compaction of 90 percent out to the finished slope face of fill slopes. This may be achieved by either overbuilding the slope and cutting back to the compacted core, or by direct compaction of the slope face with suitable equipment.
2. Slopes trimmed to the compacted core should be overbuilt by at least three (3) feet with compaction efforts out to the edge of the false slope. Failure to properly compact the outer edge results in trimming not exposing the compacted core and additional compaction after trimming may be necessary.
3. If fill slopes are built "at grade" using direct compaction methods, then the slope construction should be performed so that a constant gradient is maintained throughout construction. Soil should not be "spilled" over the slope face nor should slopes be "pushed out" to obtain grades. Compaction equipment should compact each lift along the immediate top of slope. Slopes should be back rolled or otherwise compacted at approximately every 4 feet vertically as the slope is built.
4. Corners and bends in slopes should have special attention during construction as these are the most difficult areas to obtain proper compaction.
5. Cut slopes should be cut to the finished surface. Excessive undercutting and smoothing of the face with fill may necessitate stabilization.

UTILITY TRENCH CONSTRUCTION AND BACKFILL

Utility trench excavation and backfill is the contractors responsibility. The geotechnical consultant typically provides periodic observation and testing of these operations. While efforts are made to make sufficient observations and tests to verify that the contractors' methods and procedures are adequate to achieve proper compaction, it is typically impractical to observe all backfill procedures. As such, it is critical that the contractor use consistent backfill procedures.

Compaction methods vary for trench compaction and experience indicates many methods can be successful. However, procedures that "worked" on previous projects may or may not prove effective on a given site. The contractor(s) should outline the procedures proposed, so that we may discuss them **prior** to construction. We will offer comments based on our knowledge of site conditions and experience.

1. Utility trench backfill in slopes, structural areas, in streets and beneath flat work or hardscape should be brought to at least optimum moisture and compacted to at least 90 percent of the laboratory standard. Soil should be moisture conditioned prior to placing in the trench.
2. Flooding and jetting are not typically recommended or acceptable for native soils. Flooding or jetting may be used with select sand having a Sand Equivalent (SE) of 30 or higher. This is typically limited to the following uses:
   a) shallow (12 + inches) under slab interior trenches and,
   b) as bedding in pipe zone.

   The water should be allowed to dissipate prior to pouring slabs or completing trench compaction.
3. Care should be taken not to place soils at high moisture content within the upper three feet of the trench backfill in street areas, as overly wet soils may impact subgrade preparation. Moisture may be reduced to 2% below optimum moisture in areas to be paved within the upper three feet below sub grade.
4. Sand backfill should not be allowed in exterior trenches adjacent to and within an area extending below a 1:1 projection from the outside bottom edge of a footing, unless it is similar to the surrounding soil.
5. Trench compaction testing is generally at the discretion of the geotechnical consultant. Testing frequency will be based on trench depth and the contractors procedures. A probing rod would be used to assess the consistency of compaction between tested areas and untested areas. If zones are found that are considered less compact than other areas, this would be brought to the contractors attention.

JOB SAFETY

General

Personnel safety is a primary concern on all job sites. The following summaries are safety considerations for use by all our employees on multi-employer construction sites. On ground personnel are at highest risk of injury and possible fatality on grading construction projects. The company recognizes that construction activities will vary on each site and that job site safety is the contractor's responsibility. However, it is, imperative that all personnel be safety conscious to avoid accidents and potential injury.

In an effort to minimize risks associated with geotechnical testing and observation, the following precautions are to be implemented for the safety of our field personnel on grading and construction projects.

1. Safety Meetings: Our field personnel are directed to attend the contractor's regularly scheduled safety meetings.
2. Safety Vests: Safety vests are provided for and are to be worn by our personnel while on the job site.
3. Safety Flags: Safety flags are provided to our field technicians; one is to be affixed to the vehicle when on site, the other is to be placed atop the spoil pile on all test pits.

In the event that the contractor's representative observes any of our personnel not following the above, we request that it be brought to the attention of our office.

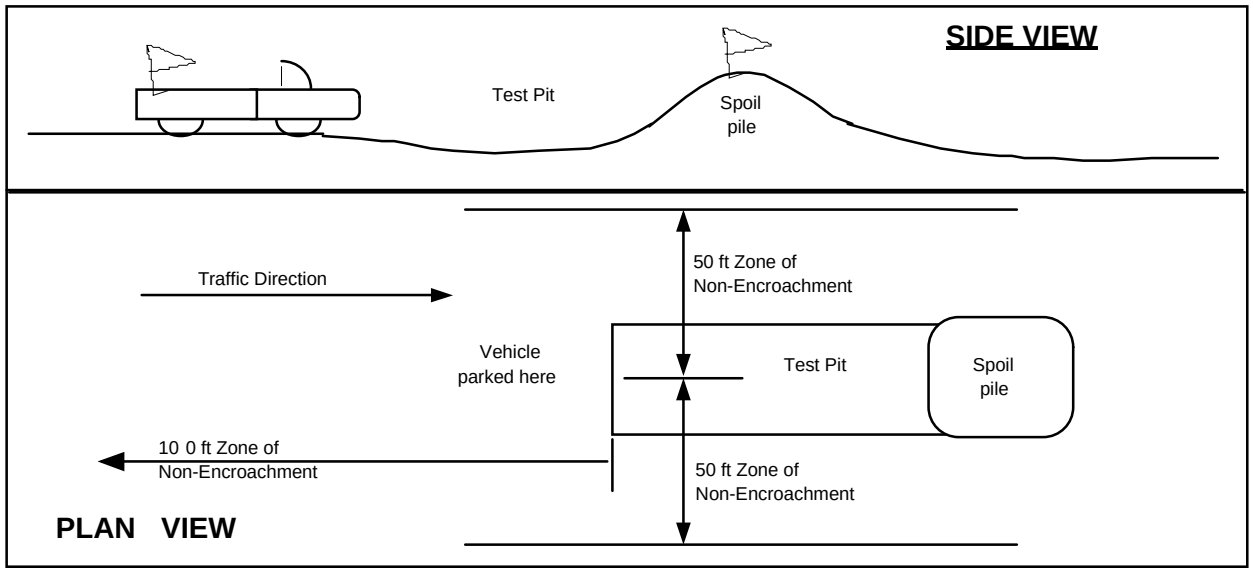
Test Pits Location, Orientation and Clearance

The technician is responsible for selecting test pit locations. The primary concern is the technician's safety. However, it is necessary to take sufficient tests at various locations to obtain a representative sampling of the fill. As such, efforts will be made to coordinate locations with the grading contractors authorized representatives (e.g. dump man, operator, supervisor, grade checker, etc.), and to select locations following or behind the established traffic pattern, preferably outside of current traffic. The contractors authorized representative should direct excavation of the pit and safety during the test period. Again, safety is the paramount concern.

Test pits should be excavated so that the spoil pile is placed away from oncoming traffic. The technician's vehicle is to be placed next to the test pit, opposite the spoil pile. This necessitates that the fill be maintained in a drivable condition. Alternatively, the contractor may opt to park a piece of equipment in front of test pits, particularly in small fill areas or those with limited access.

A zone of non-encroachment should be established for all test pits (see diagram below). No grading equipment should enter this zone during the test procedure. The zone should extend outward to the sides approximately 50 feet from the center of the test pit and 100 feet in the direction of traffic flow. This zone is established both for safety and to avoid excessive ground vibration, which typically decreases test results.

TEST PIT SAFETY PLAN



Slope Tests

When taking slope tests, the technician should park their vehicle directly above or below the test location on the slope. The contractor's representative should effectively keep all equipment at a safe operation distance (e.g. 50 feet) away from the slope during testing.

The technician is directed to withdraw from the active portion of the fill as soon as possible following testing. The technician's vehicle should be parked at the perimeter of the fill in a highly visible location.

Trench Safety

It is the contractor's responsibility to provide safe access into trenches where compaction testing is needed. Trenches for all utilities should be excavated in accordance with CAL-OSHA and any other applicable safety standards. Safe conditions will be required to enable compaction testing of the trench backfill.

All utility trench excavations in excess of 5 feet deep, which a person enters, are to be shored or laid back. Trench access should be provided in accordance with OSHA standards. Our personnel are directed not to enter any trench by being lowered or "riding down" on the equipment.

Our personnel are directed not to enter any excavation which;

1. is 5 feet or deeper unless shored or laid back,
2. exit points or ladders are not provided,
3. displays any evidence of instability, has any loose rock or other debris which could fall into the trench, or
4. displays any other evidence of any unsafe conditions regardless of depth.

If the contractor fails to provide safe access to trenches for compaction testing, our company policy requires that the soil technician withdraws and notifies their supervisor. The contractors representative will then be contacted in an effort to effect a solution. All backfill not tested due to safety concerns or other reasons is subject to reprocessing and/or removal.

Procedures

In the event that the technician's safety is jeopardized or compromised as a result of the contractor's failure to comply with any of the above, the technician is directed to inform both the developer's and contractor's representatives. If the condition is not rectified, the technician is required, by company policy, to immediately withdraw and notify their supervisor. The contractor's representative will then be contacted in an effort to effect a solution. No further testing will be performed until the situation is rectified. Any fill placed in the interim can be considered unacceptable and subject to reprocessing, recompaction or removal.

In the event that the soil technician does not comply with the above or other established safety guidelines, we request that the contractor bring this to technicians attention and notify our project manager or office. Effective communication and coordination between the contractors' representative and the field technician(s) is strongly encouraged in order to implement the above safety program and safety in general.

The safety procedures outlined above should be discussed at the contractor's safety meetings. This will serve to inform and remind equipment operators of these safety procedures particularly the zone of non-encroachment.

The safety procedures outlined above should be discussed at the contractor's safety meetings. This will serve to inform and remind equipment operators of these safety procedures particularly the zone of non-encroachment.

APPENDIX G
Preliminary Project Specific Water Quality Management Plan

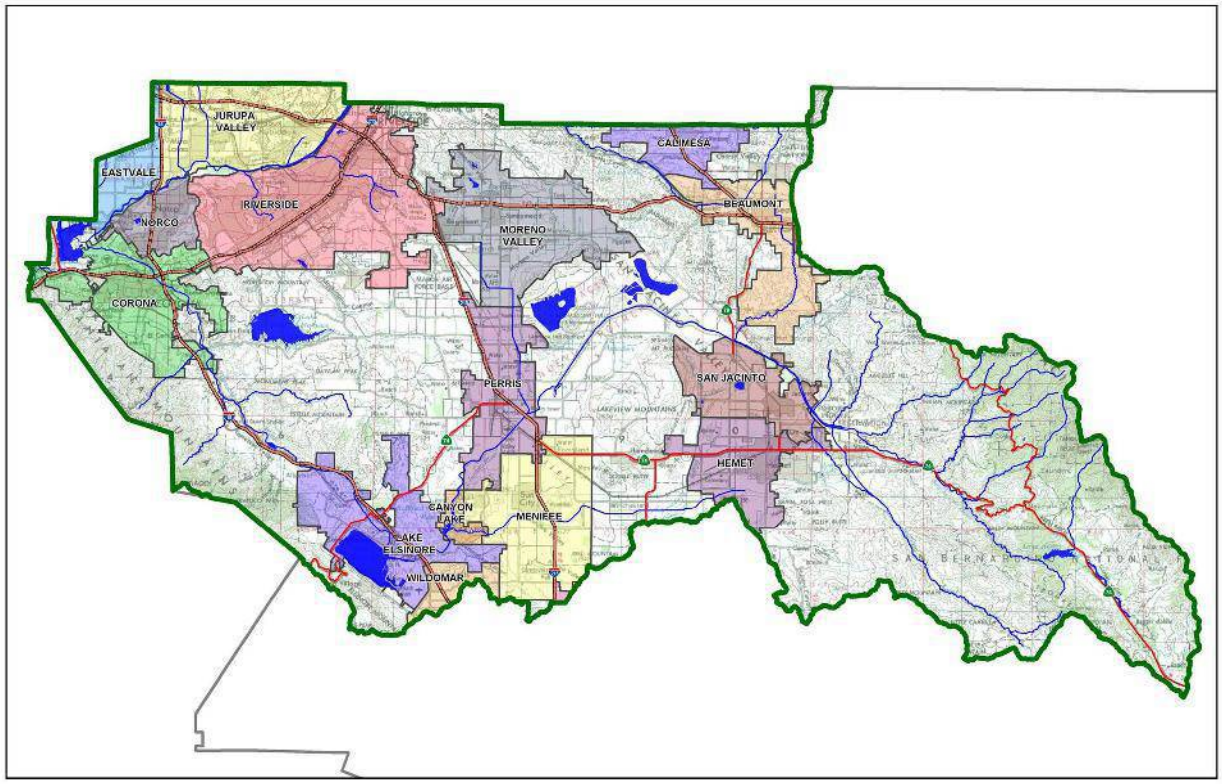
Project Specific Water Quality Management Plan

Indoor Nursery Warehouse Development

Project Title: Indoor Nursery Warehouse Development (24 Malbert Street, Perris, CA 92571)

Development No: TBD

Design Review/Case No: TBD



☒ **Preliminary**
☐ **Final**

Original Date Prepared: 2019-10-09

Revision Date(s): N/A

Prepared for Compliance with
Regional Board Order No. **R8-2010-0033**

Prepared for:
TBD
Phone TBD
Contact: TBD

Prepared by:
DRC Engineering, Inc.
160 S. Old Springs Road, Suite 210
Anaheim Hills, CA 92808
(714) 685-6860

OWNER'S CERTIFICATION

This Project-Specific Water Quality Management Plan (WQMP) has been prepared for **Error! Reference source not found.** by DRC Engineering, Inc. for the proposed Warehouse Development.

This WQMP is intended to comply with the requirements of city of Perris for Water Quality Ordinance 1194, which includes the requirement for the preparation and implementation of a Project-Specific WQMP.
The undersigned, while owning the property/project described in the preceding paragraph, shall be responsible for the implementation and funding of this WQMP and will ensure that this WQMP is amended as appropriate to reflect up-to-date conditions on the site. In addition, the property owner accepts responsibility for interim operation and maintenance of Stormwater BMPs until such time as this responsibility is formally transferred to a subsequent owner. This WQMP will be reviewed with the facility operator, facility supervisors, employees, tenants, maintenance and service contractors, or any other party (or parties) having responsibility for implementing portions of this WQMP. At least one copy of this WQMP will be maintained at the project site or project office in perpetuity. The undersigned is authorized to certify and to approve implementation of this WQMP. The undersigned is aware that implementation of this WQMP is enforceable under Perris Water Quality Ordinance (Municipal Code Section 1194)

"I, the undersigned, certify under penalty of law that the provisions of this WQMP have been reviewed and accepted and that the WQMP will be transferred to future successors in interest."

Owner's Signature	Date
Owner's Printed Name	Owner's Title/Position

PREPARER'S CERTIFICATION

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan meet the requirements of Regional Water Quality Control Board Order No. **R8-2010-0033** and any subsequent amendments thereto."

Preparer's Signature	Date
Christopher McKee	P.E.
Preparer's Printed Name	Preparer's Title/Position

Preparer's Licensure:

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List of Tables

List of Appendices

Section A: Project and Site Information

PROJECT INFORMATION	
Type of Project:	Industrial
Planning Area:	General Industrial
Community Name:	N/A
Development Name:	Proposed Warehouse Development
PROJECT LOCATION	
Latitude & Longitude (DMS): 33°46'03.4"N 117°13'44.5"W	
Project Watershed and Sub-Watershed: Santa Ana River Watershed, San Jacinto River Basin Sub-Watershed	
APN(s): 330-040-062	
Map Book and Page No.: Thomas Guide p. 807, G5	
PROJECT CHARACTERISTICS	
Proposed or Potential Land Use(s)	Industrial
Proposed or Potential SIC Code(s)	– Industrial
Area of Impervious Project Footprint (SF)	101,200
Total Area of proposed Impervious Surfaces within the Project Limits (SF)/or Replacement	101,200
Does the project consist of offsite road improvements?	☐ Y ☒ N
Does the project propose to construct unpaved roads?	☐ Y ☒ N
Is the project part of a larger common plan of development (phased project)?	☐ Y ☒ N
EXISTING SITE CHARACTERISTICS	
Total area of existing Impervious Surfaces within the project limits (SF)	0
Is the project located within any MSHCP Criteria Cell?	☐ Y ☒ N
If so, identify the Cell number:	(N/A)
Are there any natural hydrologic features on the project site?	☐ Y ☒ N
Is a Geotechnical Report attached?	☒ Y ☐ N
If no Geotech. Report, list the NRCS soils type(s) present on the site (A, B, C and/or D)	(N/A)
What is the Water Quality Design Storm Depth for the project?	0.60"

The project site is located in the City of Perris, Riverside County, California. It is situated north of Malbert Street. The site is bounded by a vacant area to the west, Malbert Street to the south, and industrial developments to the north and east. The project site consists of approximately 2.6 acres of vacant land that is 100% pervious.

The project will construct 3 warehouse buildings with parking areas, driveways, landscape areas and infrastructure to serve the lot. The project site drainage consists of one primary drainage management area that will be directed towards a series of on-site grated drop inlets (with filter inserts) and be conveyed to an underground combined infiltration and detention system (see full-sized drainage exhibit in Appendix 2). Over flow from the LID BMP system will be conveyed by a private storm drain system to the existing public storm drain system via surface flow on Malbert Street.

An underground infiltration system is proposed to mitigate the LID BMP and HCOC. The detention system will consist of 7 rows of perforated 36" diameter HDPE pipes. A total of 11,800 CF will be retained and infiltrated on-site to satisfy treatment volume requirements and to address HCOC resulting

from the increased runoff from the 2-year 24-hour storm. See Appendix 6 for unit hydrograph calculation. The proposed detention system will provide a total storage volume of 12,440 CF.

On-site infiltration is proposed to treat the storm water. A diversion manhole equipped with an orifice plate will route the excess runoff beyond the design treatment flow to Malbert Street while mitigating peak flows so as not to exceed existing.

The infiltration rate for soil on-site is assumed to be 0.5 in/hr and less (Appendix 3). Per Guidance Document for the Santa Ana Region of Riverside County WQMP, Section 2.4.5:

If the average 'in-situ' tested infiltration rate for the site is less than 1.6 inches per hour, LID infiltration BMPs (infiltration basins, infiltration trenches, etc.) shall not be used.

The proposed site will have approximately 2.1 acres of impervious area, which is 82% percent of the site. All paved areas will be used for sidewalks, parking spaces and drive aisles. Landscaping will comprise approximately 0.5 acres of the site. Landscaped areas will be located throughout the parking area and around the perimeter of the site. Plants with low irrigation requirements will be chosen for efficient irrigation purposes.

The routinely conducted outdoor activities will include the selling of related items, the loading and unloading of products and parking of vehicles on the site. All products will be loaded and unloaded only at designated loading areas. All other routinely conducted activities will occur inside the building. No car repair or food preparation is proposed for the site.

The following lists, but not limited to, the activity restriction in the site:

- Prohibit the blowing, sweeping, or hosing of debris (leaf litter, grass clippings, litter, etc.) into streets, sidewalks, parking lots, storm drain inlets, or other conveyances.
- Require dumpster lids to be closed at all times when not being loaded/unloaded.
- Prohibiting public access to the detention and the storm drain systems
- Maintenance agreements for common areas include drive aisles, parking areas, storm drain system, water quality BMPs and landscaping.
- Prohibit the dumping or disposal of debris (leaf litter, grass clippings, litter, etc.) into streets, sidewalks, parking lots, storm drain inlets, landscaped areas or other conveyances.

The property owner will be responsible for the long-term maintenance and funding of all onsite BMPs. Refer to Appendix 9 of this WQMP for entities that will be responsible for implementing the WQMP.

A.1 Maps and Site Plans

The following exhibits are included in Appendix 1:

- Location Map
- Receiving Water Map
- WQMP Site Plan
- WQMP details

A.2 Identify Receiving Waters

The receiving waters that the project site is tributary to are listed in Table A.1 below in order of upstream to downstream. A map of the receiving waters is included in Appendix 1.

Table A.1 Identification of Receiving Waters

Receiving Waters	EPA Approved 303(d) List Impairments	Designated Beneficial Uses	Proximity to RARE Beneficial Use
San Jacinto River Reach 3 (HU#802.11)	N/A	AGR, GWR, REC 1, REC 2, WARM, WILD	N/A
San Jacinto River Reach 2 (Canyon Lake) (HU# 802.11 & 802.12)	Nutrients, Pathogens	MUN, AGR, GWR, REC 1, REC 2, WARM, WILD	N/A
San Jacinto River Reach (HU# 802.32 & 802.31)	N/A	MUN, AGR, GWR, REC 1, REC 2, WARM, WILD	N/A
Lake Elsinore (HU# 802.31)	Nutrients, Organic Enrichment/Low Dissolved Oxygen, PCBs, Sediment Toxicity, Unknown Toxicity	REC 1, REC 2, WARM, WILD	N/A

A.3 Additional Permits/Approvals required for the Project:

Table A.2 Other Applicable Permits

Agency	Permit Required	
State Department of Fish and Game, 1602 Streambed Alteration Agreement	☐ Y	☒ N
State Water Resources Control Board, Clean Water Act (CWA) Section 401 Water Quality Cert.	☐ Y	☒ N
US Army Corps of Engineers, CWA Section 404 Permit	☐ Y	☒ N
US Fish and Wildlife, Endangered Species Act Section 7 Biological Opinion	☐ Y	☒ N
Statewide Construction General Permit Coverage	☒ Y	☐ N
Statewide Industrial General Permit Coverage	☒ Y	☐ N
Western Riverside MSHCP Consistency Approval (e.g., JPR, DBESP)	☐ Y	☒ N
Other *(please list in the space below as required)*	☐ Y	☐ N

Section B: Optimize Site Utilization (LID Principles)

Review of the information collected in Section 'A' will aid in identifying the principal constraints on site design and selection of LID BMPs as well as opportunities to reduce imperviousness and incorporate LID Principles into the site and landscape design. For example, **constraints** might include impermeable soils, high groundwater, groundwater pollution or contaminated soils, steep slopes, geotechnical instability, high-intensity land use, heavy pedestrian or vehicular traffic, utility locations or safety concerns. **Opportunities** might include existing natural areas, low areas, oddly configured or otherwise unbuildable parcels, easements and landscape amenities including open space and buffers (which can double as locations for bioretention BMPs), and differences in elevation (which can provide hydraulic head). Prepare a brief narrative for each of the site optimization strategies described below. This narrative will help you as you proceed with your LID design and explain your design decisions to others.

The 2010 Santa Ana MS4 Permit further requires that LID Retention BMPs (Infiltration Only or Harvest and Use) be used unless it can be shown that those BMPs are infeasible. Therefore, it is important that your narrative identify and justify if there are any constraints that would prevent the use of those categories of LID BMPs. Similarly, you should also note opportunities that exist which will be utilized during project design. Upon completion of identifying Constraints and Opportunities, include these on your WQMP Site plan in Appendix 1.

Site Optimization

The following questions are based upon Section 3.2 of the WQMP Guidance Document. Review of the WQMP Guidance Document will help you determine how best to optimize your site and subsequently identify opportunities and/or constraints, and document compliance.

Did you identify and preserve existing drainage patterns? If so, how? If not, why?

The site is currently vacant and has been rough graded to drain to the existing gutter along Malbert Street. In the proposed condition, the storm water from the site will discharge into the proposed underground detention system. In the case of the detention system overflow, the overflow will discharge into the existing gutter.

Did you identify and protect existing vegetation? If so, how? If not, why?

The existing site is vacant and existing vegetation consists of sparse growth of seasonal weeds and grasses. There are no existing trees or year-round vegetation to be protected.

Did you identify and preserve natural infiltration capacity? If so, how? If not, why?

Areas not requiring compaction will be staked off to preserve the natural infiltration capacity.

Did you identify and minimize impervious area? If so, how? If not, why?

Proposed pervious area is shown to the maximum extent practicable while still allowing for other impervious site design requirements (e.g. amount of parking stalls and building footprints)

Did you identify and disperse runoff to adjacent pervious areas? If so, how? If not, why?

Runoff will be collected at localized drains and routed to an underground system for infiltration. Overflow from the site will discharge into the existing gutter along Malbert Street.

Section C: Delineate Drainage Management Areas (DMAs)

Utilizing the procedure in Section 3.3 of the WQMP Guidance Document which discusses the methods of delineating and mapping your project site into individual DMAs, complete Table C.1 below to appropriately categorize the types of classification (e.g., Type A, Type B, etc.) per DMA for your project site. Upon completion of this table, this information will then be used to populate and tabulate the corresponding tables for their respective DMA classifications.

The project site is delineated into 2 Drainage Management Areas (DMAs). The DMA map is included in Appendix 1. The design calculations are included in Appendix 6.

Table C.1 DMA Classifications

DMA Name or ID	Surface Type(s)[1]	Area (Sq. Ft.)	DMA Type
A1	Landscape	9,016	Area draining to BMPs
A2	Landscape	184	Area draining to BMPs
A3	Landscape	1,291	Area draining to BMPs
A4	Landscape	287	Area draining to BMPs
A5	Landscape	382	Area draining to BMPs
A6	Landscape	193	Area draining to BMPs
A7	Landscape	197	Area draining to BMPs
A8	Landscape	237	Area draining to BMPs
A9	Landscape	256	Area draining to BMPs
A10	Landscape	125	Area draining to BMPs
A11	Landscape	125	Area draining to BMPs
A12	Roof	3,000	Area draining to BMPs
A13	Roof	15,000	Area draining to BMPs
A14	Roof	15,000	Area draining to BMPs
A15	Hardscape, parking, drive aisles	19,171	Area draining to BMPs
A16	Hardscape, parking, drive aisles	32,975	Area draining to BMPs
A17	Hardscape, parking, drive aisles	5,553	Area draining to BMPs
A18	Hardscape, parking, drive aisles	2,670	Area draining to BMPs
A19	Hardscape, parking, drive aisles	2,227	Area draining to BMPs
A20	Hardscape, parking, drive aisles	5,604	Area draining to BMPs

[1]*Reference Table 2-1 in the WQMP Guidance Document to populate this column*

Table C.2 Type 'A', Self-Treating Areas

DMA Name or ID	Area (Sq. Ft.)	Stabilization Type	Irrigation Type (if any)
N/A			

Table C.3 Type 'B', Self-Retaining Areas

Self-Retaining Area				Type 'C' DMAs that are draining to the Self-Retaining Area		
DMA Name/ID	Post-Project Surface Type	Area (sf) [A]	Storm Depth (in) [B]	DMA Name/ID	[C] from Table C.4	Required Retention Depth (in) [D]
N/A						

$$[D] = [B] + \frac{[B] \cdot [C]}{[A]}$$

Table C.4 Type 'C', Areas that Drain to Self-Retaining Areas

DMA					Receiving Self-Retaining DMA		
DMA Name/ID	Area (sf) [A]	Post-project surface type	Runoff factor [B]	Product [C] = [A] x [B]	DMA Name/ID	Area (sf) [D]	Ratio [C]/[D]
N/A							

Table C.5 Type 'D', Areas Draining to BMPs

DMA Name or ID	BMP Name or ID
A1	BMP A
A2	BMP A
A3	BMP A
A4	BMP A
A5	BMP A
A6	BMP A
A7	BMP A
A8	BMP A
A9	BMP A
A10	BMP A
A11	BMP A
A12	BMP A
A13	BMP A
A14	BMP A
A15	BMP A
A16	BMP A
A17	BMP A
A18	BMP A
A19	BMP A
A20	BMP A

Section D: Implement LID BMPs

D.1 Infiltration Applicability

Is there an approved downstream 'Highest and Best Use' for stormwater runoff (see discussion in Chapter 2.4.4 of the WQMP Guidance Document for further details)? ☐ Y ☒ N

If yes has been checked, Infiltration BMPs shall not be used for the site.

Geotechnical Report

A Geotechnical Report or Phase I Environmental Site Assessment may be required by the Co-permittee to confirm present and past site characteristics that may affect the use of Infiltration BMPs. In addition, the Co-Permittee, at their discretion, may not require a geotechnical report for small projects as described in Chapter 2 of the WQMP Guidance Document. If a geotechnical report has been prepared, include it in Appendix 3. In addition, if a Phase I Environmental Site Assessment has been prepared, include it in Appendix 4.

Is this project classified as a small project consistent with the requirements of Chapter 2 of the WQMP Guidance Document? ☐ Y ☒ N

Infiltration Feasibility

Table D.1 Infiltration Feasibility

Does the project site…	YES	NO
…have any DMAs with a seasonal high groundwater mark shallower than 10 feet?		X
If Yes, list affected DMAs:		
…have any DMAs located within 100 feet of a water supply well?		X
If Yes, list affected DMAs:		
…have any areas identified by the geotechnical report as posing a public safety risk where infiltration of stormwater could have a negative impact?		X
If Yes, list affected DMAs:		
…have measured in-situ infiltration rates of less than 1.6 inches / hour?	X	
If Yes, list affected DMAs: A2		
…have significant cut and/or fill conditions that would preclude in-situ testing of infiltration rates at the final infiltration surface?		X
If Yes, list affected DMAs:		
…geotechnical report identify other site-specific factors that would preclude effective and safe infiltration?		X
Describe here:		

D.2 Harvest and Use Assessment

Please check what applies*:*

☐ Reclaimed water will be used for the non-potable water demands for the project.

☐ Downstream water rights may be impacted by Harvest and Use as approved by the Regional Board (verify with the Copermittee).

☒ The Design Capture Volume will be addressed using Infiltration Only BMPs. In such a case, Harvest and Use BMPs are still encouraged, but it would not be required if the Design Capture Volume will be infiltrated or evapotranspired.

If any of the above boxes have been checked, Harvest and Use BMPs need not be assessed for the site. If neither of the above criteria applies, follow the steps below to assess the feasibility of irrigation use, toilet use and other non-potable uses (e.g., industrial use).

Irrigation Use Feasibility

The following steps are used to determine the feasibility of harvesting stormwater runoff for Irrigation Use BMPs on this site:

Step 1: Identify the total area of irrigated landscape on the site, and the type of landscaping used.

Total Area of Irrigated Landscape:

Type of Landscaping (Conservation Design or Active Turf):

Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for irrigation use. Depending on the configuration of buildings and other impervious areas on the site, you may consider the site as a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

Total Area of Impervious Surfaces:

Step 3: Cross reference the Design Storm depth for the project site (see Exhibit A of the WQMP Guidance Document) with the left column of Table 2-3 in Chapter 2 to determine the minimum area of Effective Irrigated Area per Tributary Impervious Area (EIATIA).

Enter your EIATIA factor:

Step 4: Multiply the unit value obtained from Step 3 by the total of impervious areas from Step 2 to develop the minimum irrigated area that would be required.

Minimum required irrigated area: acres

Step 5: Determine if harvesting stormwater runoff for irrigation use is feasible for the project by comparing the total area of irrigated landscape (Step 1) to the minimum required irrigated area (Step 4).

Minimum required irrigated area (Step 4)	Available Irrigated Landscape (Step 1)

Toilet Use Feasibility

Complete the following steps to determine the feasibility of harvesting stormwater runoff for toilet flushing uses on this site:

Step 1: Identify the projected total number of daily toilet users during the wet season, and account for any periodic shut downs or other lapses in occupancy:

Projected Number of Daily Toilet Users:

Project Type:

Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for toilet use. Depending on the configuration of buildings and other impervious areas on the site, the site may be considered as a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

Total Area of Impervious Surfaces:

Step 3: Enter the Design Storm depth for the project site (see Exhibit A) into the left column of Table 2-1 in Chapter 2 to determine the minimum number or toilet users per tributary impervious acre (TUTIA).

Enter your TUTIA factor:

Step 4: Multiply the unit value obtained from Step 3 by the total of impervious areas from Step 2 to develop the minimum number of toilet users that would be required.

Minimum number of toilet users:

Step 5: Determine if harvesting stormwater runoff for toilet flushing use is feasible for the project by comparing the Number of Daily Toilet Users (Step 1) to the minimum required number of toilet users (Step 4).

Minimum required Toilet Users (Step 4)	**Projected number of toilet users (Step 1)**

Other Non-Potable Use Feasibility

Are there other non-potable uses for stormwater runoff on the site (e.g. industrial use)? See Chapter 2 of the Guidance for further information. If yes, describe below. If no, write N/A.

N/A

Step 1: Identify the projected average daily non-potable demand, in gallons per day, during the wet season and accounting for any periodic shut downs or other lapses in occupancy or operation.

Average Daily Demand: _____ gpd

Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for the identified non-potable use. Depending on the configuration of buildings and other impervious areas on the site, the site may be considered as a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

Total Area of Impervious Surfaces: _____ acres

Step 3: Enter the Design Storm depth for the project site (see Exhibit A) into the left column of Table 2-3 in Chapter 2 to determine the minimum demand for non-potable uses per tributary impervious acre.

Enter the factor from Table 2-3: _____

Step 4: Multiply the unit value obtained from Step 4 by the total of impervious areas from Step 3 to develop the minimum number of gallons per day of non-potable use that would be required.

Minimum required use: _____ *gpd*

Step 5: Determine if harvesting stormwater runoff for other non-potable use is feasible for the project by comparing the Number of Daily Toilet Users (Step 1) to the minimum required number of toilet users (Step 4).

Minimum required non-potable use (Step 4)	**Projected average daily use (Step 1)**
_____ gpd	_____ gpd

If Irrigation, Toilet and Other Use feasibility anticipated demands are less than the applicable minimum values, Harvest and Use BMPs are not required and you should proceed to utilize LID Bioretention and Biotreatment, unless a site-specific analysis has been completed that demonstrates technical infeasibility as noted in D.3 below.

D.3 Bioretention and Biotreatment Assessment

Other LID Bioretention and Biotreatment BMPs as described in Chapter 2.4.7 of the WQMP Guidance Document are feasible on nearly all development sites with sufficient advance planning.

Select one of the following:

☒ LID Bioretention/Biotreatment BMPs will be used for some or all DMAs of the project as noted below in Section D.4 (note the requirements of Section 3.4.2 in the WQMP Guidance Document).

☐ A site-specific analysis demonstrating the technical infeasibility of all LID BMPs has been performed and is included in Appendix 5.

D.4 Feasibility Assessment Summaries

From the Infiltration, Harvest and Use, Bioretention and Biotreatment Sections above, complete Table D.2 below to summarize which LID BMPs are technically feasible, and which are not, based upon the established hierarchy.

Table D.2 LID Prioritization Summary Matrix

DMA Name/ID	LID BMP Hierarchy				No LID (Alternative Compliance)
	1. Infiltration	2. Harvest and use	3. Bioretention	4. Biotreatment	
A1	☒	☐	☐	☐	☐
A2	☒	☐	☐	☐	☐
A3	☒	☐	☐	☐	☐
A4	☒	☐	☐	☐	☐
A5	☒	☐	☐	☐	☐
A6	☒	☐	☐	☐	☐
A7	☒	☐	☐	☐	☐
A8	☒	☐	☐	☐	☐
A9	☒	☐	☐	☐	☐
A10	☒	☐	☐	☐	☐
A11	☒	☐	☐	☐	☐
A12	☒	☐	☐	☐	☐
A13	☒	☐	☐	☐	☐
A14	☒	☐	☐	☐	☐
A15	☒	☐	☐	☐	☐
A16	☒	☐	☐	☐	☐
A17	☒	☐	☐	☐	☐
A18	☒	☐	☐	☐	☐
A19	☒	☐	☐	☐	☐
A20	☒	☐	☐	☐	☐

D.5 LID BMP Sizing

Each LID BMP must be designed to ensure that the Design Capture Volume will be addressed by the selected BMPs. First, calculate the Design Capture Volume for each LID BMP using the VBMP worksheet in Appendix F of the LID BMP Design Handbook. Second, design the LID BMP to meet the required VBMP using a method approved by the Copermittee. Utilize the worksheets found in the LID BMP Design Handbook or consult with your Copermittee to assist you in correctly sizing your LID BMPs. Complete Table D.3 below to document the Design Capture Volume and the Proposed Volume for each LID BMP. Provide the completed design procedure sheets for each LID BMP in Appendix 6. You may add additional rows to the table below as needed.

Table D.3 DCV Calculations for LID BMPs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Enter BMP Name / Identifier Here* **Detention & Infiltration System**		
	[A]		[B]	[C]	[A] x [C]			
A1	*9016*	*Ornamental Landscaping*	*0.1*	0.11	995.9			
A2	*184*	*Ornamental Landscaping*	*0.1*	0.11	20.3			
A3	*1291*	*Ornamental Landscaping*	*0.1*	0.11	142.6			
A4	*287*	*Ornamental Landscaping*	*0.1*	0.11	31.7			
A5	*382*	*Ornamental Landscaping*	*0.1*	0.11	42.2			
A6	*193*	*Ornamental Landscaping*	*0.1*	0.11	21.3			
A7	*197*	*Ornamental Landscaping*	*0.1*	0.11	21.8			
A8	*237*	*Ornamental Landscaping*	*0.1*	0.11	26.2			
A9	*256*	*Ornamental Landscaping*	*0.1*	0.11	28.3			
A10	*125*	*Ornamental Landscaping*	*0.1*	0.11	13.7			
A11	*125*	*Ornamental Landscaping*	*0.1*	0.11	13.8			
A12	*3000*	*Roofs*	*1*	0.89	2676			
A13	*15000*	*Roofs*	*1*	0.89	13380			
A14	*15000*	*Roofs*	*1*	0.89	13380			
A15	*19171*	*Concrete or Asphalt*	*1*	0.89	17100.5			
A16	*32975*	*Concrete or Asphalt*	*1*	0.89	29413.7			
A17	*5553*	*Concrete or Asphalt*	*1*	0.89	4953.3			
A18	*2670*	*Concrete or Asphalt*	*1*	0.89	2381.6			
A19	*2227*	*Concrete or Asphalt*	*1*	0.89	1986.5			
A20	*5604*	*Concrete or Asphalt*	*1*	0.89	4998.8			
						Design Storm Depth (in)	*Design Capture Volume,* $\mathbf{V_{BMP}}$ *(cubic feet)*	*Proposed Treated Volume on Plans (cf)*
	$A_T = \Sigma[A]$ = 113492				Σ= [D] =91628.2	[E] = 0.60	$[F] = \frac{[D]x[E]}{12}$ = 4581.4	[G] =11,800

[B], [C] is obtained as described in Section 2.3.1 of the WQMP Guidance Document

[E] is obtained from Exhibit A in the WQMP Guidance Document

[G] is obtained from a design procedure sheet, such as in LID BMP Design Handbook and placed in Appendix 6

Section E: Alternative Compliance (LID Waiver Program)

LID BMPs are expected to be feasible on virtually all projects. Where LID BMPs have been demonstrated to be infeasible as documented in Section D, other Treatment Control BMPs must be used (subject to LID waiver approval by the Copermittee). Check one of the following Boxes:

☒ LID Principles and LID BMPs have been incorporated into the site design to fully address all Drainage Management Areas. No alternative compliance measures are required for this project and thus this Section is not required to be completed.

- *Or* -

☐ The following Drainage Management Areas are unable to be addressed using LID BMPs. A site-specific analysis demonstrating technical infeasibility of LID BMPs has been approved by the Co-Permittee and included in Appendix 5. Additionally, no downstream regional and/or sub-regional LID BMPs exist or are available for use by the project. The following alternative compliance measures on the following pages are being implemented to ensure that any pollutant loads expected to be discharged by not incorporating LID BMPs, are fully mitigated.

E.1 Identify Pollutants of Concern

The project's receiving waters and their associated EPA approved 303(d) listed impairments are cross referenced with the pollutants of the selected Priority Development Project Category in Table E.1 below. The project's Pollutants of Concern are indicated on the last row of the table.

Table E.1 Potential Pollutants by Land Use Type

Priority Development Project Categories and/or Project Features (check those that apply)	General Pollutant Categories							
	Bacterial Indicators	Metals	Nutrients	Pesticides	Toxic Organic Compounds	Sediments	Trash & Debris	Oil & Grease
☐ Detached Residential Development	P	N	P	P	N	P	P	P
☐ Attached Residential Development	P	N	P	P	N	P	P	P(2)
☒ Commercial/Industrial Development	P(3)	P	P(1)	P(1)	P(5)	P(1)	P	P
☐ Automotive Repair Shops	N	P	N	N	P(4, 5)	N	P	P
☐ Restaurants (>5,000 ft^2)	P	N	N	N	N	N	P	P
☐ Hillside Development (>5,000 ft^2)	P	N	P	P	N	P	P	P
☒ Parking Lots (>5,000 ft^2)	P(6)	P	P(1)	P(1)	P(4)	P(1)	P	P
☐ Retail Gasoline Outlets	N	P	N	N	P	N	P	P
Project Priority Pollutant(s) of Concern	☒	☒	☒	☒	☒	☒	☒	☒

P = Potential

N = Not Potential

(1) A potential Pollutant if non-native landscaping exists or is proposed onsite; otherwise not expected

(2) A potential Pollutant if the project includes uncovered parking areas; otherwise not expected

(3) A potential Pollutant is land use involving animal waste

(4) Specifically petroleum hydrocarbons

(5) Specifically solvents

(6) Bacterial indicators are routinely detected in pavement runoff

E.2 Stormwater Credits

Projects that cannot implement LID BMPs but nevertheless implement smart growth principles are potentially eligible for Stormwater Credits. Table 3-8 within the WQMP Guidance Document is utilized to identify the Project Category and its associated Water Quality Credit. If not applicable, write N/A.

Table E.2 Water Quality Credits

Qualifying Project Categories	Credit Percentage[2]
(N/A)	
Total Credit Percentage[1]	

[1]Cannot Exceed 50%

[2]Obtain corresponding data from Table 3-8 in the WQMP Guidance Document

E.3 Sizing Criteria

N/A

E.4 Treatment Control BMP Selection

Treatment Control BMPs typically provide proprietary treatment mechanisms to treat potential pollutants in runoff, but do not sustain significant biological processes. Treatment Control BMPs must have a removal efficiency of a medium or high effectiveness as quantified below:

- **High**: equal to or greater than 80% removal efficiency
- **Medium**: between 40% and 80% removal efficiency

Such removal efficiency documentation (e.g., studies, reports, etc.) as further discussed in Chapter 3.5.2 of the WQMP Guidance Document, must be included in Appendix 6. In addition, ensure that proposed Treatment Control BMPs are properly identified on the WQMP Site Plan in Appendix 1.

Table E.3 Treatment Control BMP Selection

Selected Treatment Control BMP Name or ID[1]	Priority Pollutant(s) of Concern to Mitigate[2]	Removal Efficiency Percentage[3]

[1] Treatment Control BMPs must not be constructed within Receiving Waters. In addition, a proposed Treatment Control BMP may be listed more than once if they possess more than one qualifying pollutant removal efficiency.

[2] Cross Reference Table E.1 above to populate this column.

[3] As documented in a Co-Permittee Approved Study and provided as follows.

[4] Per Table 4.3 Relative Treatment Performance Ratings of Treatment Control BMPs from Orange County TGD for The Preparation of Conceptual/Preliminary and/or Project WQMPs, December 20, 2013

Section F: Hydromodification

F.1 Hydrologic Conditions of Concern (HCOC) Analysis

Once it is determined that the LID design is adequate to address water quality requirements, it will need to be assessed if the proposed LID Design may still create a HCOC. Review Chapters 2 and 3 (including Figure 3-7) of the WQMP Guidance Document to determine if this project must mitigate for Hydromodification impacts. If this project meets one of the following criteria which will be indicated by the check boxes below, Hydromodification does not need to be addressed at this time. However, if the project does not qualify for Exemptions 1, 2 or 3, then additional measures must be added to the design to comply with HCOC criteria. This is discussed in further detail below in Section F.2.

HCOC EXEMPTION 1: The Priority Development Project disturbs less than one acre. The Copermittee has the discretion to require a Project-Specific WQMP to address HCOCs on projects less than one acre on a case by case basis. The disturbed area calculation should include all disturbances associated with larger common plans of development.

Does the project qualify for this HCOC Exemption? ☐ Y ☒ N

If Yes, HCOC criteria do not apply.

HCOC EXEMPTION 2: The volume and time of concentration[1] of storm water runoff for the post-development condition is not significantly different from the pre-development condition for a 2-year return frequency storm (a difference of 5% or less is considered insignificant) using one of the following methods to calculate:

- Riverside County Hydrology Manual
- Technical Release 55 (TR-55): Urban Hydrology for Small Watersheds (NRCS 1986), or derivatives thereof, such as the Santa Barbara Urban Hydrograph Method
- Other methods acceptable to the Co-Permittee

Does the project qualify for this HCOC Exemption? ☐ Y ☒ N

If Yes, report results in Table F.1 below and provide your substantiated hydrologic analysis in Appendix 7.

Table F.1 Hydrologic Conditions of Concern Summary

	2 year – 24 hour		
	Pre-condition	**Post-condition**	**% Difference**
Time of Concentration			
Volume (Cubic Feet)			

[1] Time of concentration is defined as the time after the beginning of the rainfall when all portions of the drainage basin are contributing to flow at the outlet.

HCOC EXEMPTION 3: All downstream conveyance channels to an adequate sump (for example, Prado Dam, Lake Elsinore, Canyon Lake, Santa Ana River, or other lake, reservoir or naturally erosion resistant feature) that will receive runoff from the project are engineered and regularly maintained to ensure design flow capacity; no sensitive stream habitat areas will be adversely affected; or are not identified on the Co-Permittees Hydromodification Sensitivity Maps.

Does the project qualify for this HCOC Exemption? ☐ Y ☒ N

If Yes, HCOC criteria do not apply and note below which adequate sump applies to this HCOC qualifier.

The site-wide HCOC design was included in the Master WQMP document.

F.2 HCOC Mitigation

If none of the above HCOC Exemption Criteria are applicable, HCOC criteria is considered mitigated if they meet one of the following conditions:

a. Additional LID BMPS are implemented onsite or offsite to mitigate potential erosion or habitat impacts as a result of HCOCs. This can be conducted by an evaluation of site-specific conditions utilizing accepted professional methodologies published by entities such as the California Stormwater Quality Association (CASQA), the Southern California Coastal Water Research Project (SCCRWP), or other Co-Permittee approved methodologies for site-specific HCOC analysis.

b. The project is developed consistent with an approved Watershed Action Plan that addresses HCOC in Receiving Waters.

c. Mimicking the pre-development hydrograph with the post-development hydrograph, for a 2-year return frequency storm. Generally, the hydrologic conditions of concern are not significant, if the post-development hydrograph is no more than 10% greater than pre-development hydrograph. In cases where excess volume cannot be infiltrated or captured and reused, discharge from the site must be limited to a flow rate no greater than 110% of the pre-development 2-year peak flow.

All pertinent documentation used in the analysis of item c is in Appendix 7.

Section G: Source Control BMPs

Source control BMPs include permanent, structural features that may be required in your project plans — such as roofs over and berms around trash and recycling areas — and Operational BMPs, such as regular sweeping and "housekeeping", that must be implemented by the site's occupant or user. The MEP standard typically requires both types of BMPs. In general, Operational BMPs cannot be substituted for a feasible and effective permanent BMP. Using the Pollutant Sources/Source Control Checklist in Appendix 8, review the following procedure to specify Source Control BMPs for your site:

1. ***Identify Pollutant Sources*:** Review Column 1 in the Pollutant Sources/Source Control Checklist. Check off the potential sources of Pollutants that apply to your site.

2. ***Note Locations on Project-Specific WQMP Exhibit*:** Note the corresponding requirements listed in Column 2 of the Pollutant Sources/Source Control Checklist. Show the location of each Pollutant source and each permanent Source Control BMP in your Project-Specific WQMP Exhibit located in Appendix 1.

3. ***Prepare a Table and Narrative*:** Check off the corresponding requirements listed in Column 3 in the Pollutant Sources/Source Control Checklist. In the left column of Table G.1 below, list each potential source of runoff Pollutants on your site (from those that you checked in the Pollutant Sources/Source Control Checklist). In the middle column, list the corresponding permanent, Structural Source Control BMPs (from Columns 2 and 3 of the Pollutant Sources/Source Control Checklist) used to prevent Pollutants from entering runoff. **Add additional narrative** in this column that explains any special features, materials or methods of construction that will be used to implement these permanent, Structural Source Control BMPs.

4. ***Identify Operational Source Control BMPs**:* To complete your table, refer once again to the Pollutant Sources/Source Control Checklist. List in the right column of your table the Operational BMPs that should be implemented as long as the anticipated activities continue at the site. Copermittee stormwater ordinances require that applicable Source Control BMPs be implemented; the same BMPs may also be required as a condition of a use permit or other revocable Discretionary Approval for use of the site.

Table G.1 Permanent and Operational Source Control Measures

Potential Sources of Runoff pollutants	Permanent Structural Source Control BMPs	Operational Source Control BMPs
On-site storm drain inlets	☒ Mark all inlets with the words "Only Rain Down the Storm Drain" or similar. Catch Basin Markers may be available from the Riverside County Flood Control and Water Conservation District, call 951.955.1200 to verify. **(CASQA BMP SC-44, "Drainage System Maintenance"; SD-13, "Storm Drain System Signs")**	☒ Maintain and periodically repaint or replace inlet markings. ☒ Provide stormwater pollution prevention information to new site owners, lessees, or operators. ☒ See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com ☒ Include the following in lease agreements: "Tenant shall not allow anyone to discharge into storm drains or to store or deposit materials so as to create a potential discharge into storm drain." ☒ Provide and periodically inspect spill kits ☒ In the case of fuel spills, follow the procedures in the Spill Response Plan and clean up with clean-up method and supplies specified in MSDSs (Material Safety Data Sheets)
Interior floor drains and elevator shafts sump pumps	☒ State that interior floor drains and elevator shafts sump pumps will be plumbed to sanitary sewer. ***Interior floor drains will be plumbed to sanitary sewer. There is no elevator shaft.***	☒ Inspect and maintain drains to prevent blockages and overflow.
Landscape/ Outdoor Pesticide Use	State that final landscape plans will accomplish all of the following. ☐ Preserve existing native trees, shrubs, and ground cover to the maximum extent possible. ☒ Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution.	☒ Maintain landscaping using minimum or no pesticides. ☒ See applicable operational BMPs in "What you should know for… Landscape and Gardening" at http://rcflood.org/stormwater/ ☒ Provide IPM (Intergraded Pest Management) information to new owners, lessees and operators. Applicable operational BMPs in "What you should know for… Landscape and Gardening":

Potential Sources of Runoff pollutants	Permanent Structural Source Control BMPs	Operational Source Control BMPs
	☒ Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions. ☒ Consider using pest-resistant plants, especially adjacent to hardscape. ☒ To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions. **(CASQA BMP SD-10 "Site Design & Landscape Planning, SD-12 "Efficient Irrigation")**	☒ Never apply pesticides or fertilizers when rain is predicted within the next 48 hours. ☒ Do not overwater. ☒ Do not rake or blow leaves, clippings or pruning waste into the street, gutter or storm drain. Dispose of green waste by composting, hauling it to a permitted landfill, or recycling it though city's program.
Refuse areas	☒ State how site refuse will be handled and provide supporting detail to what is shown on plans. ***Refuse will be picked up by local waste management company on a weekly basis. Detail of the trash enclosure will be provided in the final WQMP.*** ☒ State that signs will be posted on or near dumpsters with the words "Do not dump hazardous materials here" or similar. **(CASQA BMP SD-32, "Trash Enclosures")**	☒ State how the following will be implemented: Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Keep receptacles covered. Prohibit/prevent dumping of liquid or hazardous wastes. Post "no hazardous materials" signs. Inspect and pick up litter daily and clean up spills immediately. Keep spill control materials available on-site. See Fact Sheet SC-34, "Waste Handling and Disposal" in the CASQA Stormwater Quality Handbooks at www.cabmpbooks.com ***Tenant of each building is responsible for the inspection and maintenance of the refuse areas as stated in the CC&R's or lease agreement.***
Vehicle and Equipment Cleaning	☐ If a car wash area is not provided, describe any measures taken to discourage on-site car washing and explain how these will be enforced. **(CASQA BMP SC-21 "Vehicle & Equipment Cleaning", SD-33**	Describe operational measures to implement the following (if applicable): ☒ Washwater from vehicle and equipment washing operations shall not be discharged to the storm drain system. Refer to "Outdoor

Potential Sources of Runoff pollutants	Permanent Structural Source Control BMPs	Operational Source Control BMPs
	"Vehicle Washing Area)	Cleaning Activities and Professional Mobile Service Providers" for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at http://rcflood.org/stormwater/
Vehicle / Equipment Repair and Maintenance	☒ State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area. ***No vehicle repair or maintenance will be done on the site.*** ☒ State that there are no floor drains or if there are floor drains, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements. ***There are floor drains in the restrooms in the buildings. The floor drains will drain into sanitary sewer line.*** ☒ State that there are no tanks, containers or sinks to be used for parts cleaning or rinsing or, if there are, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements. ***There are not tanks, containers or sinks to be used for parts cleaning or rinsing.***	In the Stormwater Control Plan, note that all of the following restrictions apply to use the site: ☒ No person shall dispose of, nor permit the disposal, directly or indirectly of vehicle fluids, hazardous materials, or rinse water from parts cleaning into storm drains. ☒ No vehicle fluid removal shall be performed outside a building, nor on asphalt or ground surfaces, whether inside or outside a building, except in such a manner as to ensure that any spilled fluid will be in an area of secondary containment. Leaking vehicle fluids shall be contained or drained from the vehicle immediately. ☒ No person shall leave unattended drip parts or other open containers containing vehicle fluid, unless such containers are in use or in an area of secondary containment. Refer to "Automotive Maintenance & Car Care Best Management Practices for Auto Body Shops, Auto Repair Shops, Car Dealerships, Gas Stations and Fleet Service Operations". Brochure can be found at http://rcflood.org/stormwater/ Refer to Outdoor Cleaning Activities and Professional Mobile Service Providers for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at http://rcflood.org/stormwater
Loading Docks	There is no loading dock proposed. However, the loading/unloading	☒ Move loaded and unloaded items indoors as soon as possible.

Potential Sources of Runoff pollutants	Permanent Structural Source Control BMPs	Operational Source Control BMPs
	activities should follow the practice outlined in **CASQA BMP SC-30, "Outdoor Loading/Unloading".**	☒ See Fact Sheet SC-30, "Outdoor Loading and Unloading," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com
Fire Sprinkler Test Water	☒ Provide a means to drain fire sprinkler test water to the sanitary sewer. ***The drain line for fire sprinkler test water will be connected to the sanitary sewer line per plumbing plan.***	☒ See the note in Fact Sheet SC-41, "Building and Grounds Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com
Miscellaneous Drain or Wash Water or Other Sources ☐ Boiler drain lines ☒ Condensate drain lines ☒ Rooftop equipment ☐ Drainage sumps ☒ Roofing, gutters, and trim ☐ Other sources	☐ Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system. ☒ Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur. Condensate drain lines may not discharge to the storm drain system. ☒ Rooftop equipment with potential to produce pollutants shall be roofed and/or have secondary containment. ☐ Any drainage sumps on-site shall feature a sediment sump to reduce the quantity of sediment in pumped water. ☒ Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff. **(CASQA BMP SD-10, "Site Design and Landscape Planning" and SD-11, "Roof Runoff Controls")**	Additional Operational BMPs suggested on Fact Sheet SC-10: ☒ Train employees to identify non-stormwater discharges and report them to the appropriate departments.
Plazas, sidewalks, and parking lots	☒ Control the number of points for vehicle access ☒ Inspect BMP's prior to forecast rain, daily during extended rain events, after rain events, weekly	☒ Sweep plazas, sidewalks, and parking lots regularly to prevent accumulation of liter and debris. Collect debris from pressure washing to prevent entry into the storm drain

Potential Sources of Runoff pollutants	Permanent Structural Source Control BMPs	Operational Source Control BMPs
	during rainy season and at two-week intervals during the non-rainy season ☒ Do not sweep up any unknown substance or any object that may be potentially hazardous ☒ After sweeping is finished, properly dispose of sweeper wastes **(CASQA BMP SE-7, "Street Sweeping and Vacuuming")**	system. Collect washwater containing any cleaning agent or degreaser and discharge to the sanitary sewer not to a storm drain.
Activity Restriction	If a property owners association (POA) is formed, conditions, covenants and restrictions shall include measures listed in BMPs for the purpose of surface water quality protection.	• Prohibit the blowing, sweeping, or hosing of debris (leaf litter, grass clippings, litter, etc.) into streets, sidewalks, parking lots, storm drain inlets, or other conveyances. • Require dumpster lids to be closed at all times when not being loaded/unloaded. • Prohibiting public access to the detention system and the storm drain system • Maintenance agreements for common areas including drive aisles, parking areas, storm drain system, water quality BMPs and landscaping. • Prohibit the dumping or disposal of debris (leaf litter, grass clippings, litter, motor oil etc.) into streets, sidewalks, parking lots, storm drain inlets, landscaped areas or other conveyances • Prohibit car repair • Prohibit food preparation

Section H: Construction Plan Checklist

Populate Table H.1 below to assist the plan checker in an expeditious review of your project. The first two columns will contain information that was prepared in previous steps, while the last column will be populated with the corresponding plan sheets. This table is to be completed with the submittal of your final Project-Specific WQMP.

Table H.1 Construction Plan Cross-reference

BMP No. or ID	BMP Identifier and Description	Corresponding Plan Sheet(s)
TC-11 (Underground Chamber System)	Underground combined infiltration & detention System	Storm Drain Plan Sheet

Note that the updated table — or Construction Plan WQMP Checklist — is **only a reference tool** to facilitate an easy comparison of the construction plans to your Project-Specific WQMP. Co-Permittee staff can advise you regarding the process required to propose changes to the approved Project-Specific WQMP.

Section I: Operation, Maintenance and Funding

Maintenance Mechanism:

The property owner will record an agreement with the County of Riverside to maintain the BMPs outlined in this report.

Will the proposed BMPs be maintained by a Home Owners' Association (HOA) or Property Owners Association (POA)?

☐ Y ☒ N

The maintenance of the proposed structure BMPs will be done by the property owner through site maintenance workers. The property owner will be responsible for funding of all onsite BMPs through its operating budget. The following party is responsible for the operation and maintenance of all Structural Source Control and Treatment Control BMPs until such time that the permanent sale of the parcel and transfer of ownership occurs:

Owner info: TBD

Contact: TBD

The owner will be responsible for ensuring that all personnel involved in the routine inspection, routine and non-routine maintenance, and record keeping tasks required by the O&M Plan are familiar with the contents of the WQMP and the requirements for the routine inspection as well as routine and non-routine tasks as described in Appendix 9. Corresponding fact sheets for source control BMPs and treatment control BMPs, as well as other educational materials, can be found in Appendix 10.

The owner will be responsible for ensuring that individuals involved in O&M activities, including but not limited to contractors, will be trained by the responsible party/trainer according to the training program herein.

Each proposed BMP for the feature developments will be maintained by the property owner.

The owner shall be responsible for documenting all training activities and for maintaining records related to training. At a minimum, training documentation shall include:

• Certification of Receipt and Review of the O&M Plan completed by trainees and owner

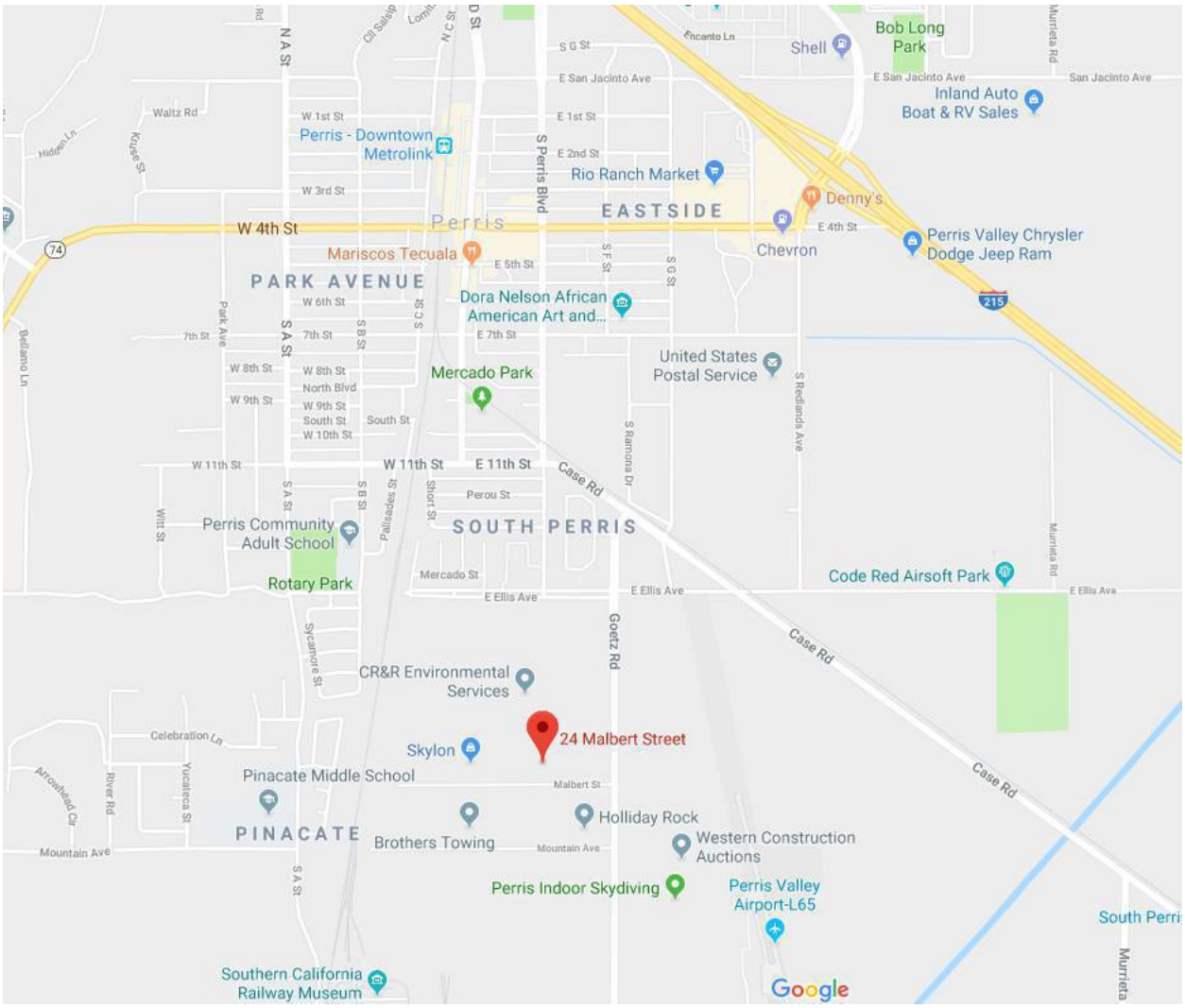
• Logging of all training activities at the same time that all training is complete.

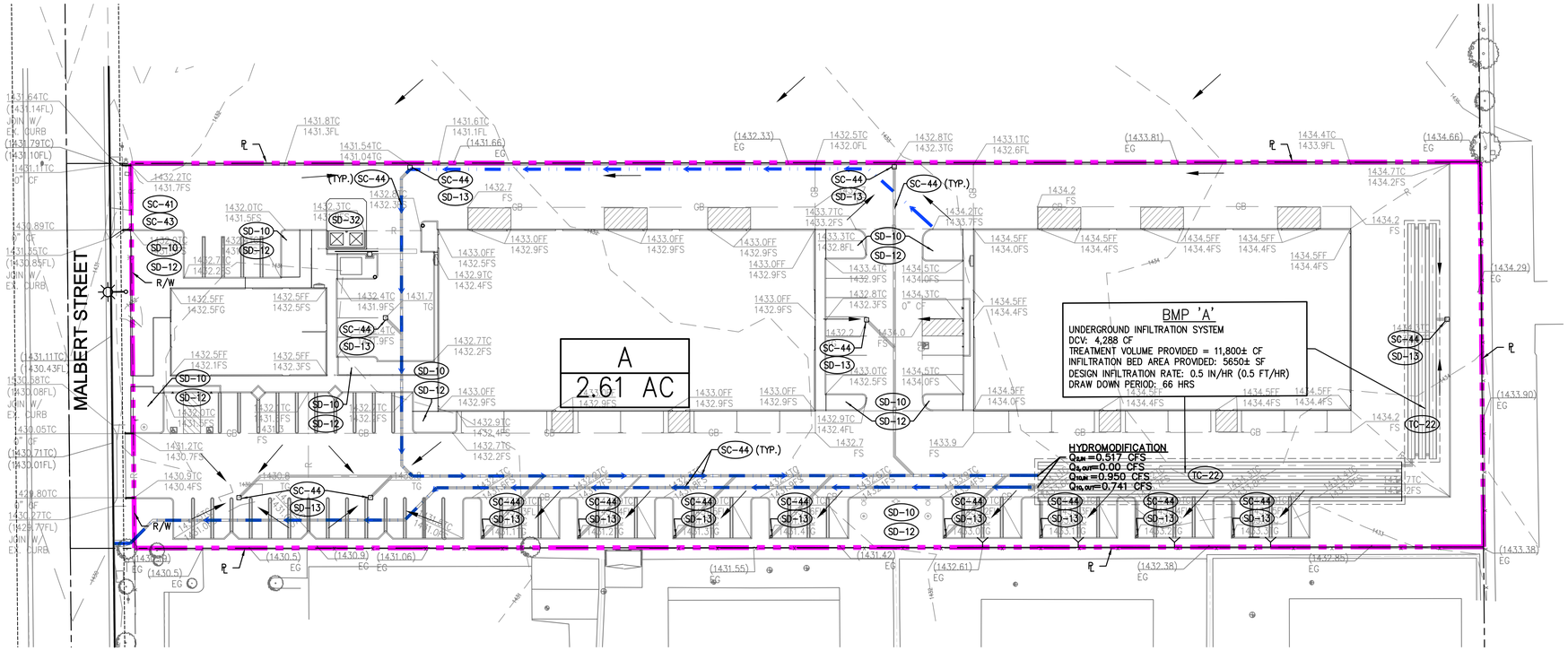
Forms for documentation of training are included in Appendix 10. Training records must be maintained for a minimum period of 3 years.

Appendix 1: Maps & Site Plans

Location Map, WQMP Site Plan, and Receiving Water Map

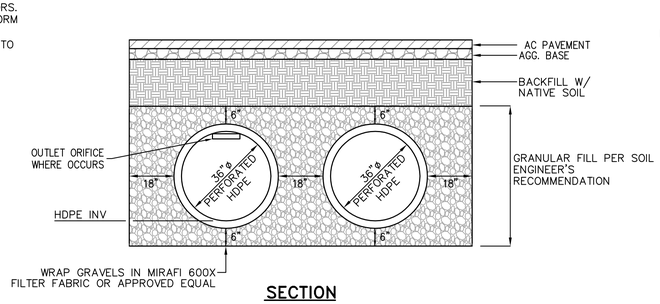
LOCATION MAP



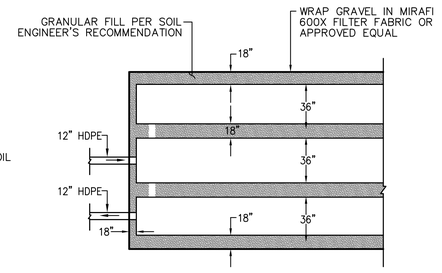


BUILDING/GENERAL SOURCE CONTROL BMP NOTES

- ALL PROCESS ACTIVITIES TO BE PERFORMED INDOORS. NO PROCESSES TO DRAIN TO EXTERIOR OR TO STORM DRAIN SYSTEM.
- NO VEHICLE/EQUIPMENT REPAIR OR MAINTENANCE TO BE PERFORMED OUTSIDE.

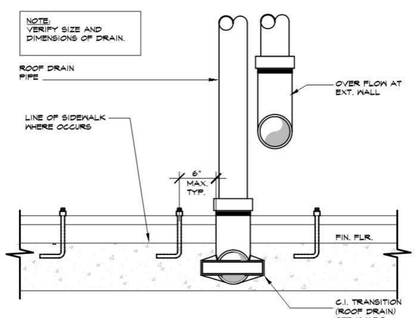


SECTION

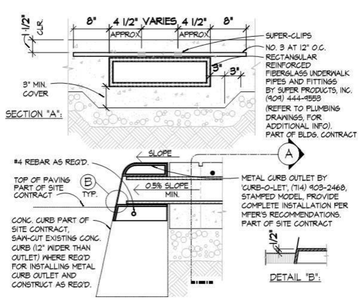


PLAN

COMBINED UNDERGORUND DETENTION & INFILTRATION SYSTEM
N.T.S.



ROOF DRAIN DISCHARGE THRU CONCRETE CURB



ROOF DRAIN UNDER WALK

ROOF DRAIN DETAILS
N.T.S.

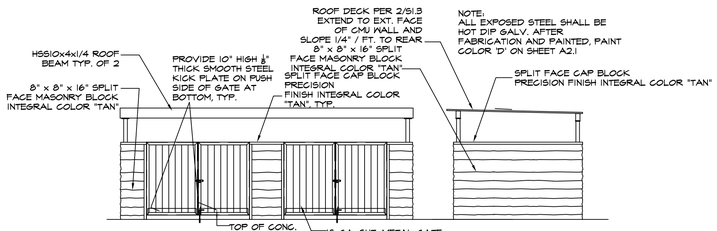
BMP NOTES

- INCIDENTAL RUN-ON EXPECTED FROM THE NORTHWEST

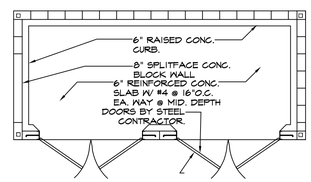
ABBREVIATION

PL	PROPERTY LINE
POC	POINT OF CONNECTION
PROP	PROPOSED
SD	STORM DRAIN

STENCIL DETAILS
N.T.S.



TRASH ENCLOSURE ELEVATIONS
NO SCALE



TRASH ENCLOSURE FLOOR PLAN
NO SCALE

SD-32 TRASH ENCLOSURE
N.T.S.

160 S. Old Springs Road
Suite 210
Anaheim Hills, CA 92808
714-685-6860
DRC Engineering, Inc.
Civil Engineering/Land Surveying/Land Planning
R.C.E. 39478
DATE
GREGORY R. COOKE

NOT FOR CONSTRUCTION

NO:	REVISION:	DATE:

PROJECT: P17-00008 INDOOR NURSERY WAREHOUSE
24 MALBERT STREET
PERRIS, CA

DRAWING NAME: POST-CONSTRUCTION BMP SITE PLAN

ISSUE:	EXHIBIT
DATE:	10-01-2019
CHECKED: CM	DRAWN: PP
DRAWING FILE:	19228WQMP
PROJECT NO.:	19-228
SHEET NUMBER:	1
OF	1 SHEETS
SCALE:	AS NOTED

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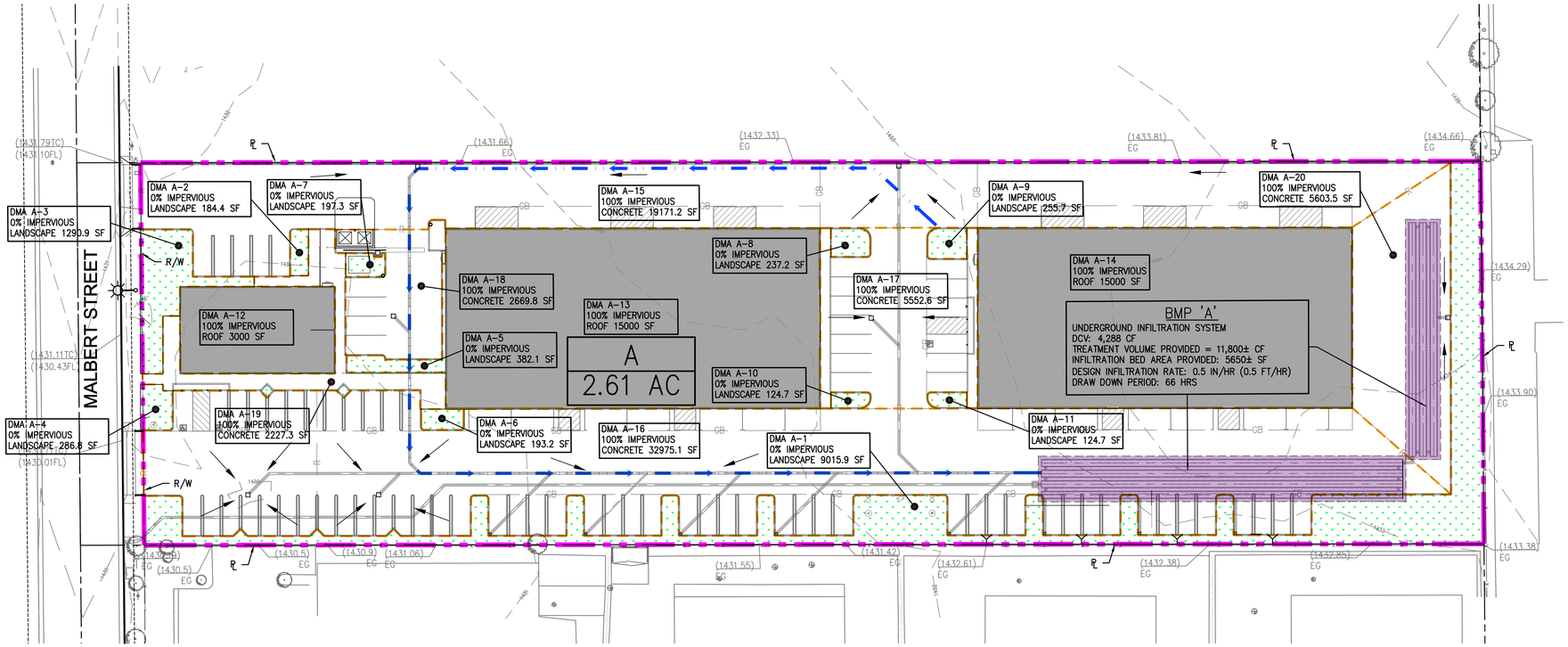

LEGEND

- DMA BOUNDARY
- SUBAREA BOUNDARY
- BUILDING ROOF AREA
- PERVIOUS LANDSCAPE AREA
- INFILTRATION & DETENTION FOOTPRINT
- X / X.XX AC — DMA NAME / DMA ACREAGE
- STORM DRAIN INLET

TOTAL SITE AREA: ±113,492 SF

PERVIOUS: ±12,292 SF 10.8%

IMPERVIOUS: ±101,200 SF 82.4%

ABBREVIATION

℄	PROPERTY LINE
POC	POINT OF CONNECTION
PROP	PROPOSED
SD	STORM DRAIN

30' 0' 30' 60' 90'

GRAPHIC SCALE: 1"=30'

DRAINAGE MANAGEMENT AREA A
DESIGN CAPTURE VOLUME

DMA ID	SURFACE DESCRIPTION	AREA SUMMARY: DMA AREA (SF)	AREA SUMMARY: RECEIVING AREA	DMA RUNOFF FACTOR	DMA AREA X RUNOFF FACTOR	DESIGN STORM DEPTH (IN)	DESIGN CAPTURE VOLUME (CF)	VOLUME PROVIDED (CF)
A-1	LANDSCAPE	9,016	BMP A	0.11	996			
A-2	LANDSCAPE	184	BMP A	0.11	20			
A-3	LANDSCAPE	1291	BMP A	0.11	143			
A-4	LANDSCAPE	287	BMP A	0.11	32			
A-5	LANDSCAPE	382	BMP A	0.11	42			
A-6	LANDSCAPE	193	BMP A	0.11	21			
A-7	LANDSCAPE	197	BMP A	0.11	22			
A-8	LANDSCAPE	237	BMP A	0.11	26			
A-9	LANDSCAPE	256	BMP A	0.11	28			
A-10	LANDSCAPE	124	BMP A	0.11	14			
A-11	LANDSCAPE	125	BMP A	0.11	14			
A-12	ROOF	3,000	BMP A	0.89	2,676			
A-13	ROOF	15,000	BMP A	0.89	13,380			
A-14	ROOF	15,000	BMP A	0.89	13,380			
A-15	CONCRETE	19,171	BMP A	0.89	17,101			
A-16	CONCRETE	32,975	BMP A	0.89	29,414			
A-17	CONCRETE	5,553	BMP A	0.89	4,953			
A-18	CONCRETE	2,670	BMP A	0.89	2,382			
A-19	CONCRETE	2,227	BMP A	0.89	1,987			
A-20	CONCRETE	5,604	BMP A	0.89	4,999			
		113,492	TOTAL		91,628	0.60	4,581	11,800

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714-685-6860

DRC Engineering, Inc.
Civil Engineering/Land Surveying/Land Planning

R.C.E. 39478
DATE
GREGORY R. COOKE

NOT FOR CONSTRUCTION

NO: REVISION: DATE:

PROJECT: P17-00008 INDOOR NURSERY WAREHOUSE
24 MALBERT STREET
PERRIS, CA

DRAWING NAME: WQMP DMA MAP

ISSUE: EXHIBIT
DATE: 10-14-2019
CHECKED: CM DRAWN: PP
DRAWING FILE: 19228WQMP
PROJECT NO.: 19-228
SHEET NUMBER: 1
OF 1 SHEETS
SCALE: AS NOTED

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R 07 W | R 06 W | R 05 W | R 04 W | R 03 W | R 02 W | R 01 W | R 01 E | R 02 E | R 03 E | R 04 E | R 05 E

T 01 S
T 02 S
T 03 S
T 04 S
T 05 S
T 06 S
T 07 S
T 08 S

06	05	04	03	02	01
07	08	09	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

0.85 MiraLoma
0.61 RiverseNorth
0.54 RiverseSouth
0.88 PradoDam
0.51 Woodcrest
0.50 LakeMathews
0.68 PigeonPass
0.66 MorenoEast
0.68 PerrisReservoir
0.85 Beaumont
0.70 SanJacintoNWS
0.87 VistaGrandeGS
1.18 Idyllwild
0.90 HurkeyCreek
0.65 Anza
0.58 SunCity
0.68 Winchester
0.70 ElsinoreNWS
1.11 ElCarisoStation
0.77 WildomarLaCresta
0.52 SkinnerLake
0.77 SantaRosaPlateau
1.00 TemeculaNWS
0.64 AguangaValley

Santa Ana River Watershed
Santa Margarita Watershed

JURUPA VALLEY | EASTVALE | NORCO | CORONA | RIVERSIDE | MORENO VALLEY | CALIMESA | BEAUMONT | SAN JACINTO | PERRIS | HEMET | CANYON LAKE | LAKE ELSINORE | MENIFEE | WILDOMAR | MURRIETA | TEMECULA

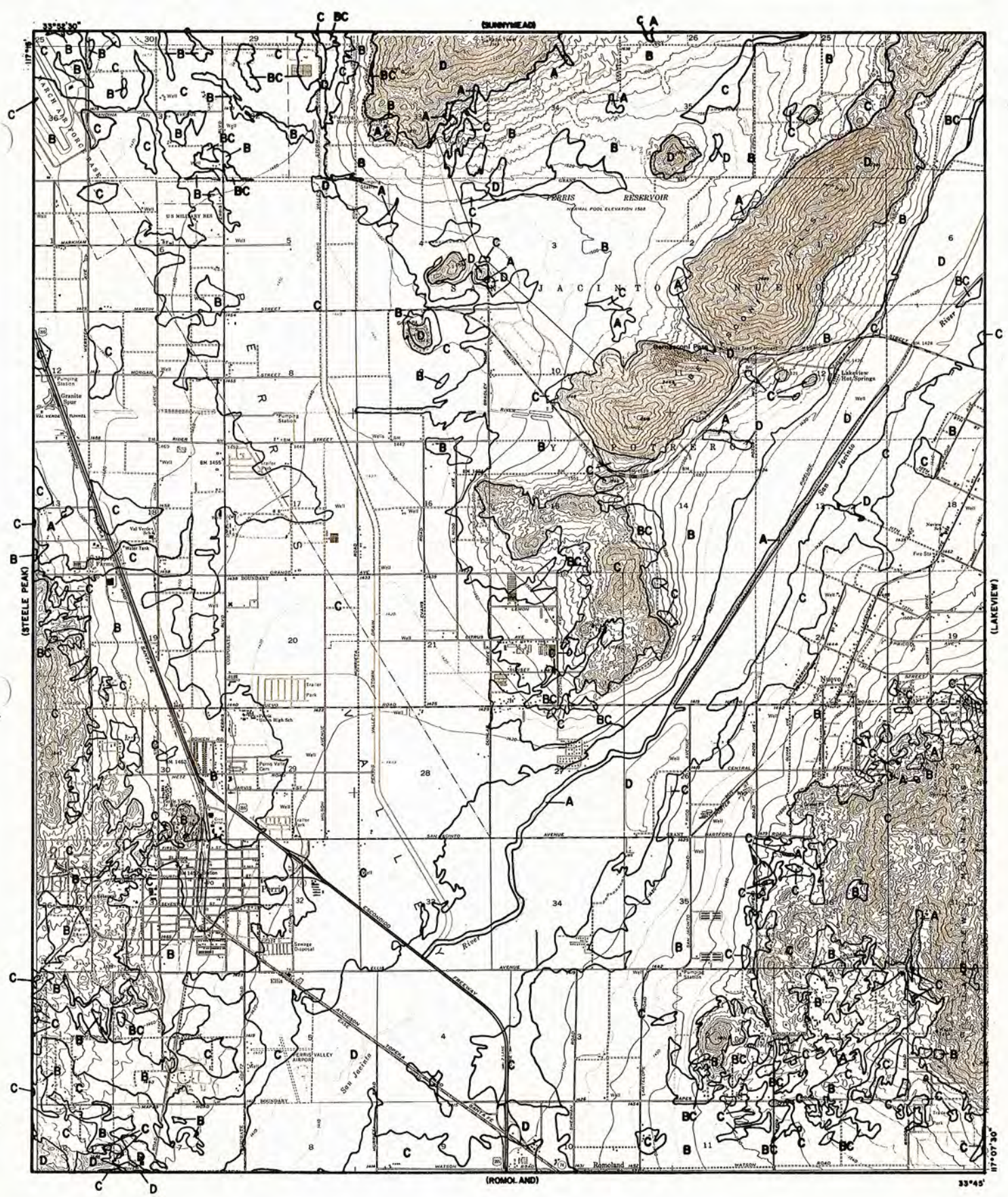
N

Rain Gage Locations

RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

Isohyetal Map for the 85th Percentile 24 hour Storm Event

July 2011



LEGEND

—— SOILS GROUP BOUNDARY

A SOILS GROUP DESIGNATION

RCFC&WCD

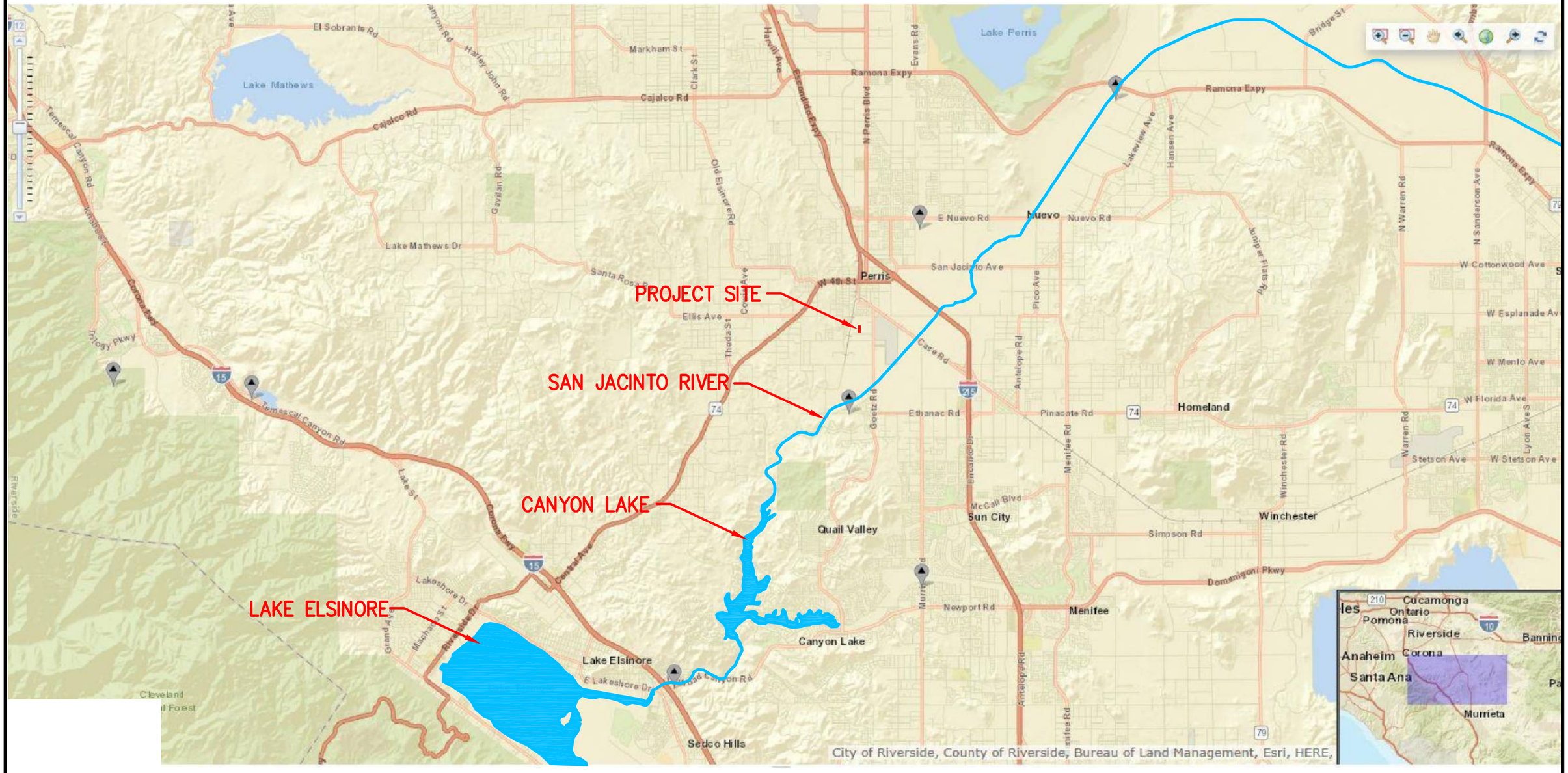
HYDROLOGY MANUAL

N

0 FEET 5000

HYDROLOGIC SOILS GROUP MAP FOR PERRIS

PLATE C-1.30



N

SCALE IN MILES

0 1 2 4 6

SCALE: 1" = 2 MILE

PROPOSED WAREHOUSE DEVELOPMENT

DOWNSTREAM RECEIVING WATERS SAN JACINTO RIVER

PERRIS, CA

DRC Engineering, Inc.
Civil Engineering/Land Surveying/Land Planning
160 S. Old Springs Road, Ste. 210
Anaheim Hills, California 92808
(714) 685-6860

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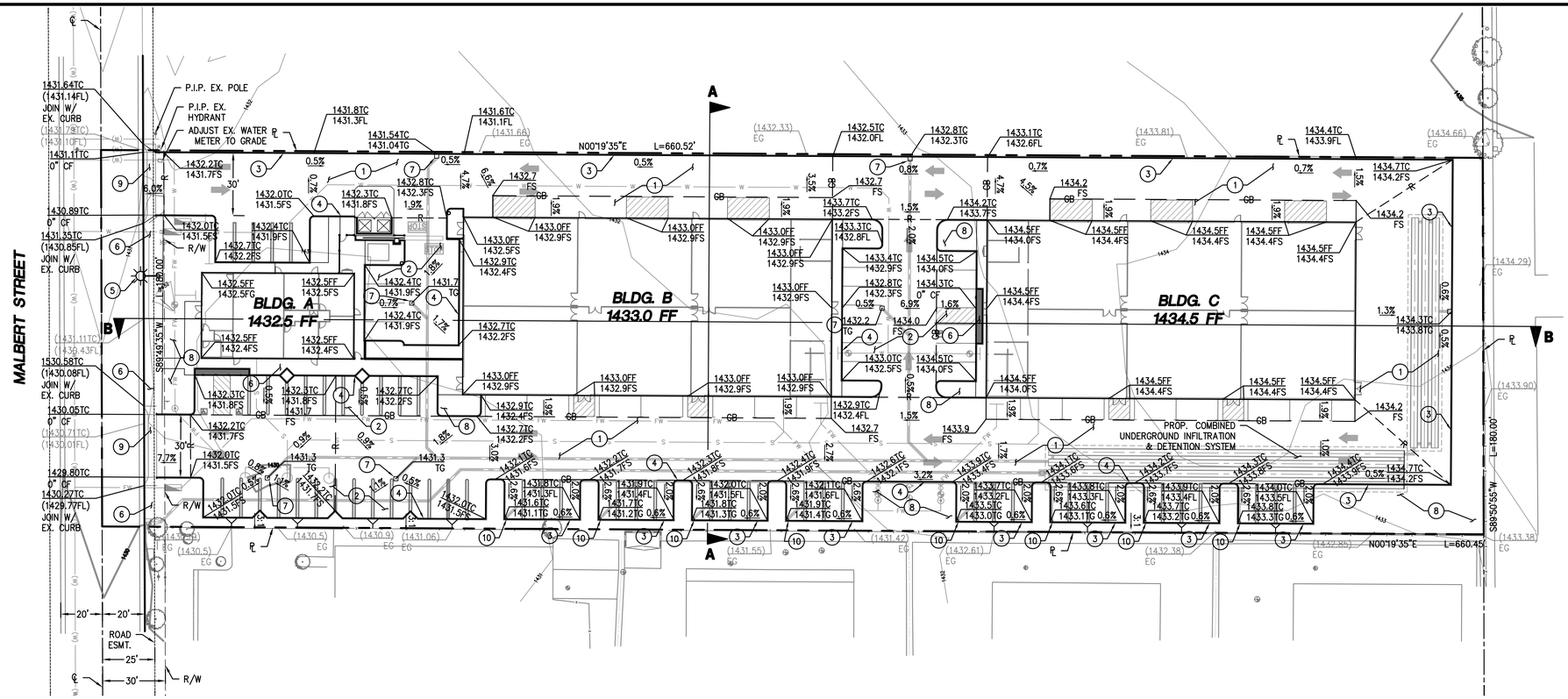
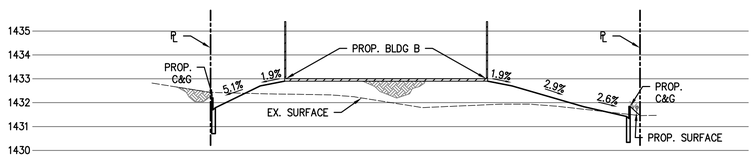
Appendix 2: Construction Plans



GRADING CONSTRUCTION NOTES	QUANTITIES
(1) CONSTRUCT HEAVY-DUTY ASPHALT PAVEMENT PER GEOTECHNICAL RECOMMENDATIONS	XX EA.
(2) CONSTRUCT LIGHT-DUTY ASPHALT PAVEMENT PER GEOTECHNICAL RECOMMENDATIONS	XX L.F.
(3) CONSTRUCT 6" CURB & GUTTER PER RIVERSIDE CO. STD. No. 200	XX L.F.
(4) CONSTRUCT 6" CURB PER SPPWC STD. No. 111-5	XX L.F.
(5) INSTALL STREET LIGHT PER CITY STANDARDS	XX L.F.
(6) CONSTRUCT SIDEWALK ADJACENT TO CURB PER RIVERSIDE CO. STD. No. 401	XX L.F.
(7) CONSTRUCT 24"X24" CONCRETE BOX PER DETAIL HEREON OR JENSEN PRECAST DI24X24	XX L.F.
(8) SEE LANDSCAPE PLANS FOR PLANTING AND IRRIGATION	
(9) CONSTRUCT COMMERCIAL DRIVEWAY PER RIVERSIDE CO. STD. No. 207A	
(10) CONSTRUCT 12"X12" CONCRETE BOX PER DETAIL HEREON OR JENSEN PRECAST DI12X12	



SECTION A-A

HORIZONTAL: 1"=30'
VERTICAL: 1"=3'

LEGAL DESCRIPTION

THE LAND REFERRED TO HEREIN IS SITUATED IN THE CITY OF PERRIS, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AND IS DESCRIBED AS FOLLOWS:

PARCEL 24, IN THE CITY OF PERRIS, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AS SHOWN BY RECORD OF SURVEY ON FILE IN BOOK 16, PAGE 14, OF RECORDS OF SURVEY, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

EXCEPT THEREFROM THE SOUTH 30 FEET AS GRANTED TO THE CITY OF PERRIS BY DEED RECORDED DECEMBER 22, 1987 AS INSTRUMENT NO. 359065 OF OFFICIAL RECORDS.

APN: 330-040-0622

BENCHMARK

COUNTY OF RIVERSIDE ID: M-26

ELEVATION: 1436.240

ESTABLISHED: 1963

DATUM: NGVD29

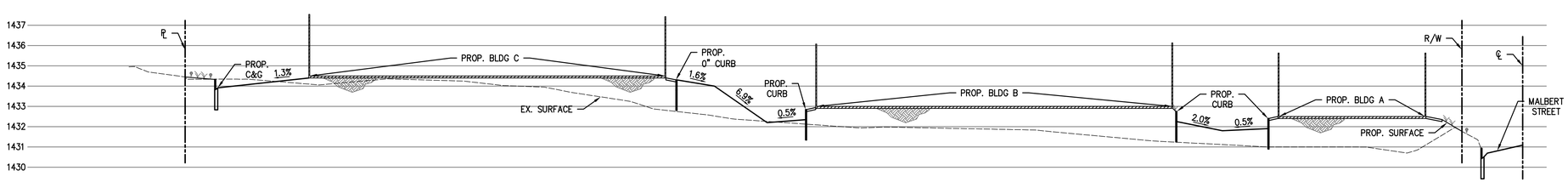
DESCRIPTION: IN THE INTERSECTION OF PERRIS BOULEVARD AND NUEVO ROAD, A 1" IRON PIPE IN A CAP WELL MONUMENT AND MARKED COUNTY SURVEYOR

EARTHWORK QUANTITY ESTIMATE

	CUT (CY)	FILL (CY)
RAW (7" SECTION ACROSS SITE)	1,300	980
STORAGE FOR UTILITIES	450	–
OVEREXCAVATION	–	–
SHRINKAGE	–	–
TOTAL	1,750	980

NET = 770 CY EXPORT

THE ABOVE QUANTITIES DO NOT REFLECT ANY SPECIAL CONDITIONS THAT MAY BE SPECIFIED IN THE PRELIMINARY SOILS REPORT AND ARE FOR REFERENCE ONLY.



SECTION B-B

HORIZONTAL: 1"=30'
VERTICAL: 1"=3'

SITE AREA

113,485.4 SF

2.61 AC

30' 0' 30' 60' 90'

GRAPHIC SCALE: 1"=30'

160 S. Old Springs Road
Suite 210
Anaheim Hills, CA 92808
714-685-6860

DRC Engineering, Inc.
Civil Engineering/Land Surveying/Land Planning

R.C.E. 39478
GREGORY R. COOKE
DATE

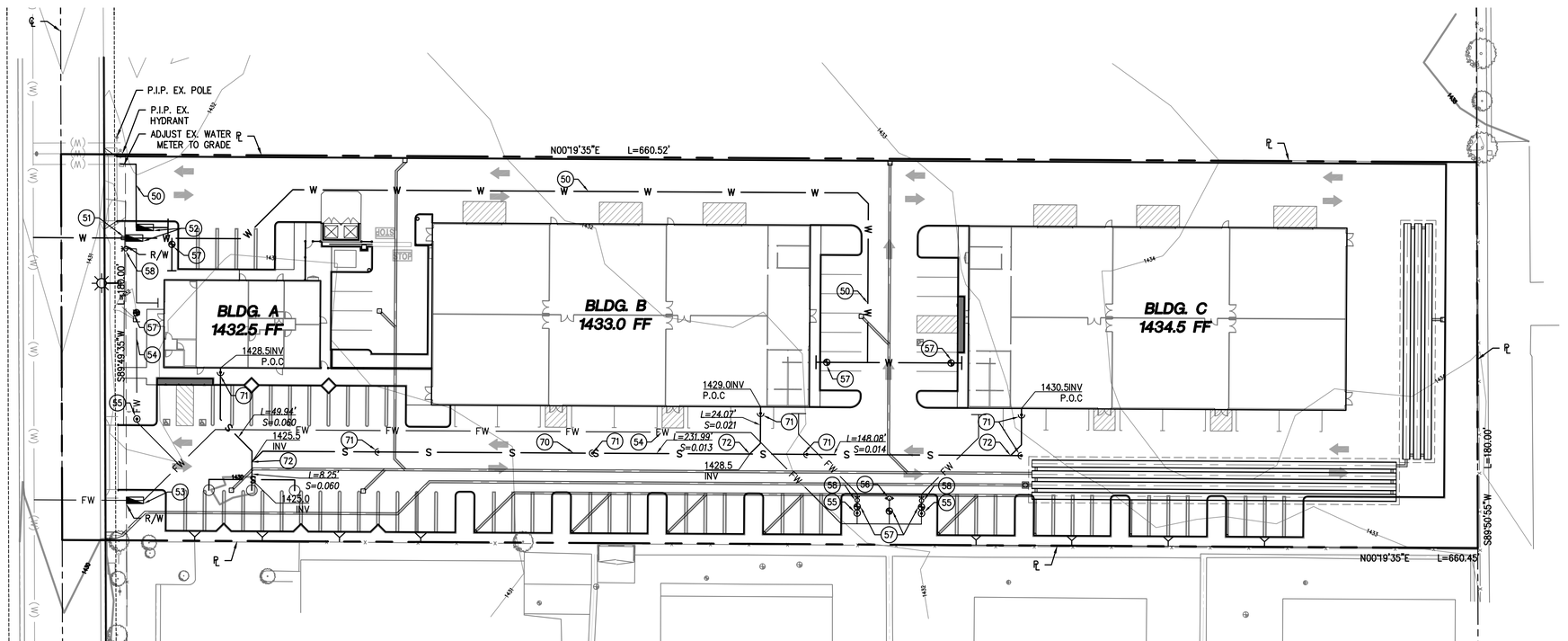
NOT FOR CONSTRUCTION

NO.: REVISION: DATE:

PROJECT: MALBERT WAREHOUSE
24 MALBERT STREET
PERRIS, CALIFORNIA

DRAWING NAME: CONCEPTUAL GRADING

ISSUE:	CG101
DATE:	09/18/2019
CHECKED: CM	DRAWN: NS
DRAWING FILE:	19228CG101
PROJECT NO.:	19-228
SHEET NUMBER:	1
OF 1	SHEETS
SCALE:	AS SHOWN



WATER CONSTRUCTION NOTES		QUANTITIES
50	INSTALL 2" PVC DOMESTIC WATER LINE	610 L.F.
51	INSTALL WATER SERVICE WITH 2" METER	1 EA.
52	INSTALL 2" DOUBLE CHECK VALVE ASSEMBLY	2 EA.
53	INSTALL 10" DOUBLE DETECTOR CHECK VALVE	1 EA.
54	INSTALL 12" PVC FIRE WATER LINE	777 L.F.
55	INSTALL POST INDICATOR VALVE	3 EA.
56	INSTALL FIRE HYDRANT	1 EA.
57	INSTALL VALVE	7 EA.
58	INSTALL FIRE DEPARTMENT CONNECTION	3 EA.

SEWER CONSTRUCTION NOTES		QUANTITIES
70	INSTALL 6" PVC SEWER	581 L.F.
71	INSTALL SEWER CLEANOUT	7 EA.
72	INSTALL FLAT PVC WYE CONNECTION	3 EA.

30' 0' 30' 60' 90'

GRAPHIC SCALE: 1"=30'

160 S. Old Springs Road
Suite 210
Anaheim Hills, CA 92808
714-685-6860

DRC Engineering, Inc.
Civil Engineering/Land Surveying/Land Planning

R.C.E. 39478
GREGORY R. COOKE
DATE

NOT FOR CONSTRUCTION

NO.: REVISION: DATE:

PROJECT: MALBERT WAREHOUSE
24 MALBERT STREET
PERRIS, CALIFORNIA

DRAWING NAME: CONCEPTUAL UTILITY

ISSUE:	CU101
DATE:	09/18/2019
CHECKED: CM	DRAWN: NS
DRAWING FILE:	19228CU101
PROJECT NO.:	19-228
SHEET NUMBER:	1
OF	1 SHEETS
SCALE:	AS SHOWN

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Appendix 3: Soils Information

Geotechnical Report

GEOTECHNICAL REPORT
PROPOSED COMMERCIAL DEVELOPMENT
MALBERT STREET
PERRIS AREA, RIVERSIDE COUNTY, CALIFORNIA

PREPARED FOR:

El Paso Oil, Inc.
8135 La Jolla Shores Drive
La Jolla, California 92037

PREPARED BY:

INLAND FOUNDATION ENGINEERING, INC.
P. O. Box 937
San Jacinto, California 92583

September 13, 2018
Project No. E137-001

INLAND FOUNDATION ENGINEERING, INC.
Consulting Geotechnical Engineers and Geologists
www.inlandfoundation.com

September 13, 2018
Project No. E137-001

EL PASO OIL, INC.
8135 La Jolla Shores Drive
La Jolla, California 92037

Attention: Mr. Michael Whitney

Subject: Preliminary Geotechnical Investigation Report
Proposed Commercial Development
Malbert Street, Perris, California
A.P.N. 330-040-062

Dear Mr. Whitney:

We are pleased to submit this preliminary geotechnical investigation report prepared for the subject project.

The results of our testing and analysis indicate that the proposed development is feasible from a geotechnical engineering standpoint. The following report includes design recommendations, along with the field and laboratory data. We have also included recommendations for site grading.

We appreciate being of service to you on this project. If you have any questions, please contact our office.

Respectfully,
INLAND FOUNDATION ENGINEERING, INC.

Daniel R. Lind, P.G., C.E.G.
Principal Geologist

Hector Marquez, E.I.T.
Staff Engineer

Allen D. Evans, P.E., G.E.
Principal

HM:DRL:ADE:es
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INTRODUCTION

This report presents the results of the preliminary geotechnical investigation conducted for a proposed commercial development located north of and adjacent to Malbert Street, west of Goetz Road in the City of Perris, Riverside County, California. The following references were provided for our use during this investigation.

- Topographic site plan entitled "Malbert Street – Perris", prepared by Michael Baker International, undated.

SCOPE OF SERVICE

The purpose of this preliminary geotechnical investigation is to provide geotechnical parameters for design and construction of the proposed project. The scope of the geotechnical services included:

- *Review of the general geologic conditions and specific subsurface conditions of the project site.*
- *Geological and seismicity evaluation of the site.*
- *Evaluation of the engineering and geologic data collected for the project site.*
- *Preparation of this report with geotechnical conclusions and recommendations for design and construction.*

The tasks performed to achieve these objectives included:

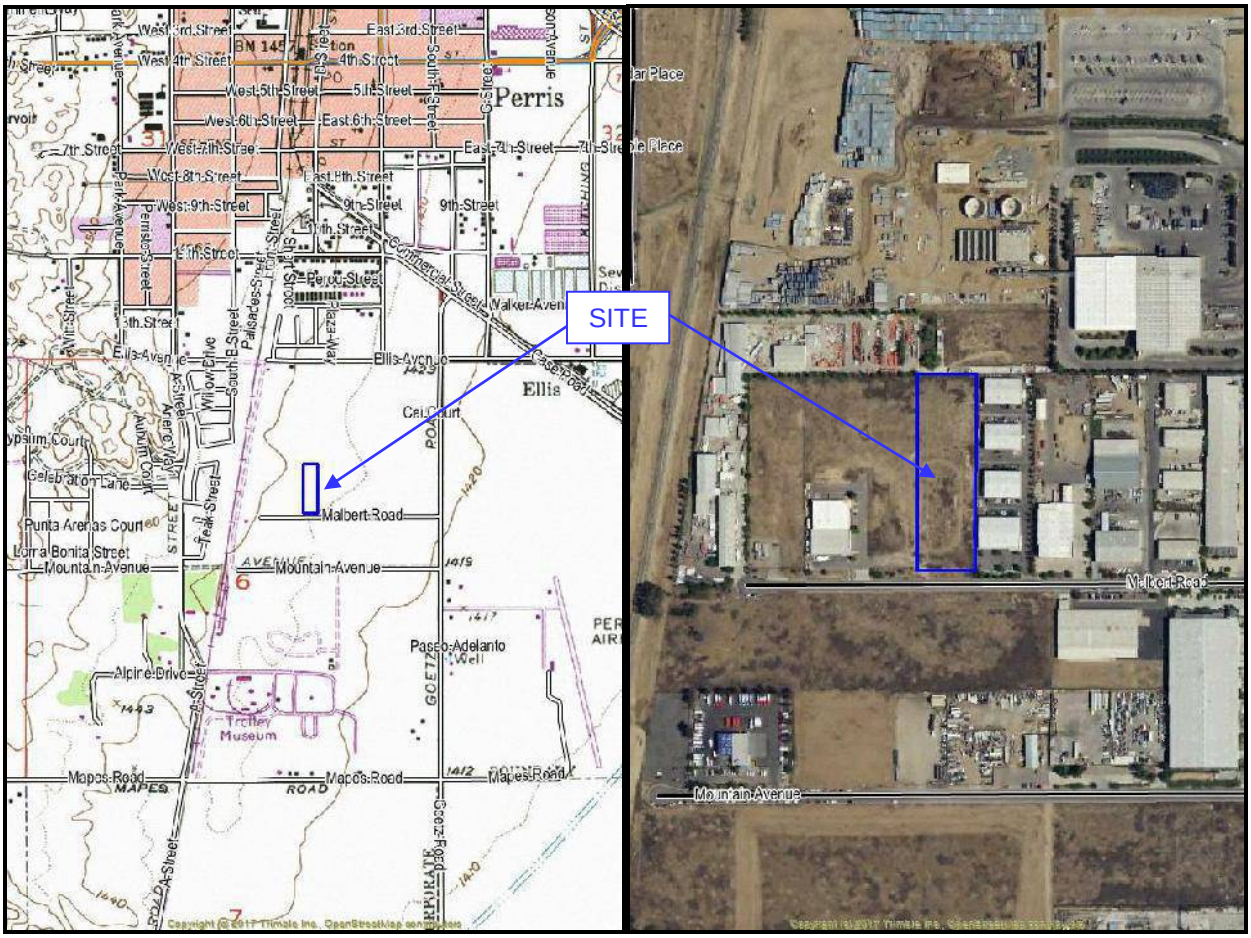
- *Collection and review of new and existing data relative to the site.*
- *Subsurface exploration to evaluate the nature and stratigraphy of the subsurface soils and to obtain representative samples for laboratory testing.*
- *Visual reconnaissance of the site and surrounding area to ascertain the presence of unstable or adverse geologic conditions.*
- *Laboratory testing of representative samples to evaluate the classification and engineering properties of the soils.*
- *Analysis of the data collected and the preparation of this report with our geotechnical conclusions and recommendations.*

Evaluation of hazardous wastes was not within the scope of service provided. Evaluation of seismic hazards was based on field mapping, literature review and limited subsurface exploration.

SITE AND PROJECT DESCRIPTION

The proposed development is located north of and adjacent to Malbert Street, west of Goetz Road, in the City of Perris, California. The project site lies within the northeast portion of Section 6, Township 5 South, Range 3 West, S.B.B.&M. The Assessor Parcel No. for the property is 330-040-062. Figure 1 below shows the location of the project site.

Figure 1: USGS Topographic Map, Perris 7.5' Quadrangle, and Aerial Photograph (2016)



The project site occupies approximately 2.61 acres. The site is currently vacant. Based on our review, the site has been historically vacant, except during 2009 and 2010. Historical aerial photographs show numerous storage containers that appear to be present on the south side of the property during that time period. A large, oval-shaped dirt trail is present on the south portion of the property. Surficial fill is also present in the northern portion of the property.

The site is located in an industrial area and is bounded by commercial developments to the north and east. The site is bounded by vacant land to the south and west.

Vegetation on-site primarily consists of a sparse growth of seasonal weeds and grasses.

The topography of the site is generally planar with a slight gradient to the south. Based on the provided topographic site plan, the elevation of the site ranges from approximately 1,437 to 1,443 feet above mean sea level (msl).

We understand that the proposed construction includes a ±3,000 square foot commercial building to be located in the southern portion of the site. A second building, comprising approximately 25,000 square feet, is planned immediately north of the first building. The exact dimensions and locations of the proposed buildings were unknown at the time this report was prepared. Dimensions and locations were assumed based on discussions with the client.

We understand that the proposed commercial buildings will be supported by continuous wall footings and slab-on-grade floors. We have not been provided with specific foundation plans or loads.

Grading is expected to consist of minor cuts and fills of less than two feet, exclusive of remedial grading as recommended in this report.

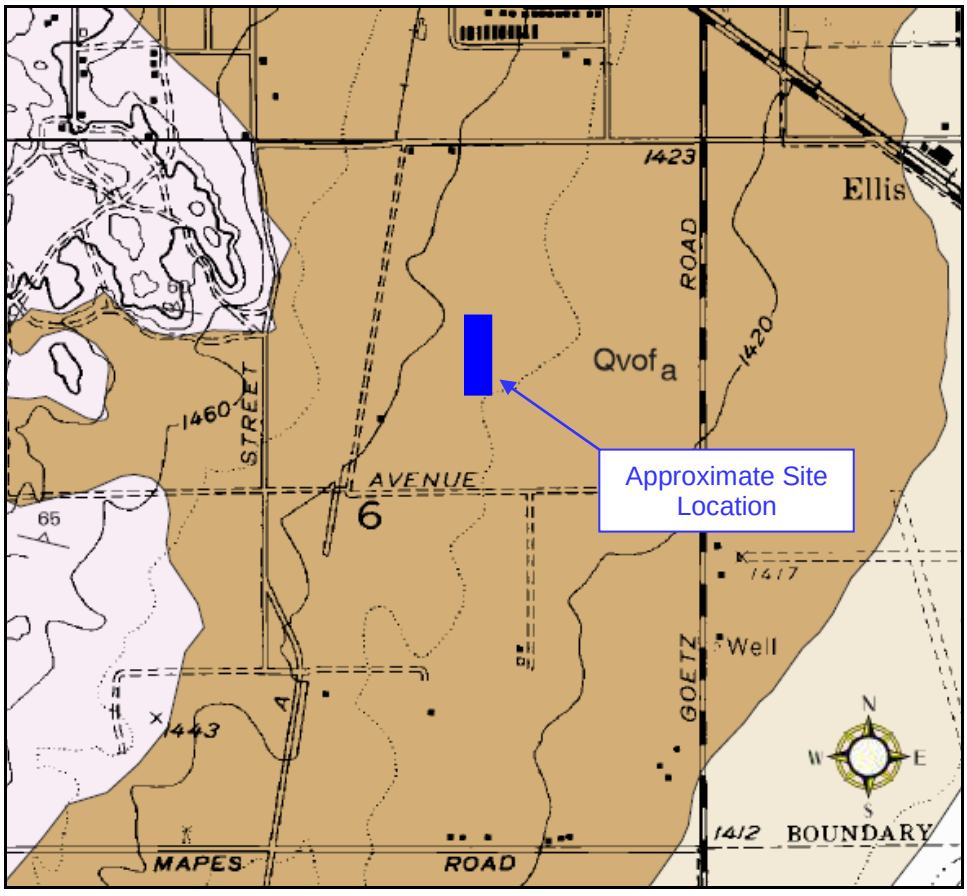
GEOLOGIC SETTING

Regional Geology: The subject site is situated within a natural geomorphic province in southwestern California known as the Peninsular Ranges, which is characterized by steep, elongated ranges and valleys that trend northwesterly. This geomorphic province encompasses an area that extends approximately 125 miles, from the Transverse Ranges and the Los Angeles Basin, south to the Mexican border, and beyond for another 795 miles to the tip of Baja California (Norris & Webb, 1990; Harden, 1998). This province is believed to have originated as a thick accumulation of predominantly marine sedimentary and volcanic rocks during the late Paleozoic and early Mesozoic. Following this accumulation, in mid-Cretaceous time, the province underwent a pronounced episode of mountain building. The accumulated rocks were then complexly metamorphosed and intruded by igneous rocks, known locally as the Southern California Batholith. A period of erosion followed the mountain building, and during the late Cretaceous and Cenozoic time, sedimentary and subordinate volcanic rocks were deposited upon the eroded surfaces of the batholithic and pre-batholithic rocks.

Local Geology: More specifically, the site is situated within the Perris Block, an eroded mass of Cretaceous and older crystalline rock. Thin sedimentary and volcanic units mantle the bedrock in a few places with alluvial deposits filling in the lower valley areas. The Perris Block is a structurally stable, internally unfaulted mass of crustal rocks bounded on the west by the Elsinore-Chino fault zones, on the east by the San Jacinto fault zone, and on the north by the Cucamonga fault zone (Woodford, et al., 1971). On the south, the Perris Block is bounded by a series of sedimentary basins that lie between Temecula and Anza (Morton and Matti, 1989).

According to the mapping by Morton (2003), the site is underlain by very old alluvial fan deposits comprised predominately of well-indurated reddish-brown sand deposits (map symbol Qvof). Figure 2 below shows a portion of the USGS Preliminary Geologic Map of the Perris 7.5' Quadrangle (Morton, 2003), showing the mapped geologic units in the vicinity of the project.

Figure 2: USGS Preliminary Geologic Map of the Perris 7.5' Quadrangle (Morton, 2003)



Qvof

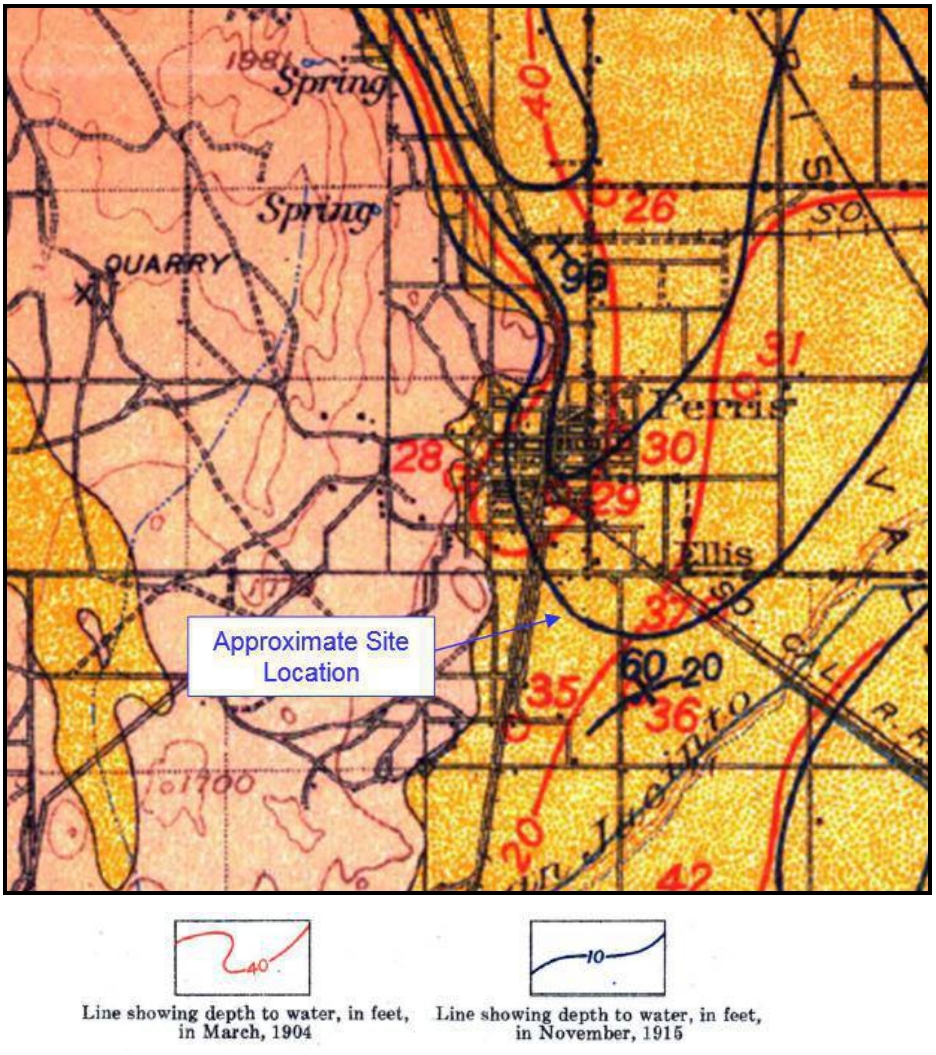
Very old alluvial-fan deposits (early Pleistocene)—Mostly well-dissected, well-indurated, reddish-brown sand deposits. Commonly contains duripans and locally silcretes. Forms large area flanking Perris Valley and west side of San Jacinto River Valley. Typically flanks steep bedrock slopes

Groundwater: Groundwater was encountered within our exploratory borings at depths ranging from approximately 36 to 38 feet below the existing ground surface.

Historical groundwater data was reviewed for this project. A report entitled Ground Water in the San Jacinto and Temecula Basins, California (U.S.G.S. Water Supply Paper 429, Waring 1919), includes a map showing depth contours to groundwater during March 1904 and November 1915 based on well data obtained from nearby wells. Extrapolation of groundwater depth contours (depth to water in feet) shown on the map indicates that the depth to water in the vicinity of the project site was approximately 30 feet below the existing ground surface in March of 1904.

Figure 3 below shows a portion of the referenced U.S.G.S. historical groundwater depth contour map.

Figure 3: Historical Groundwater Depth Contours (Waring, 1919)



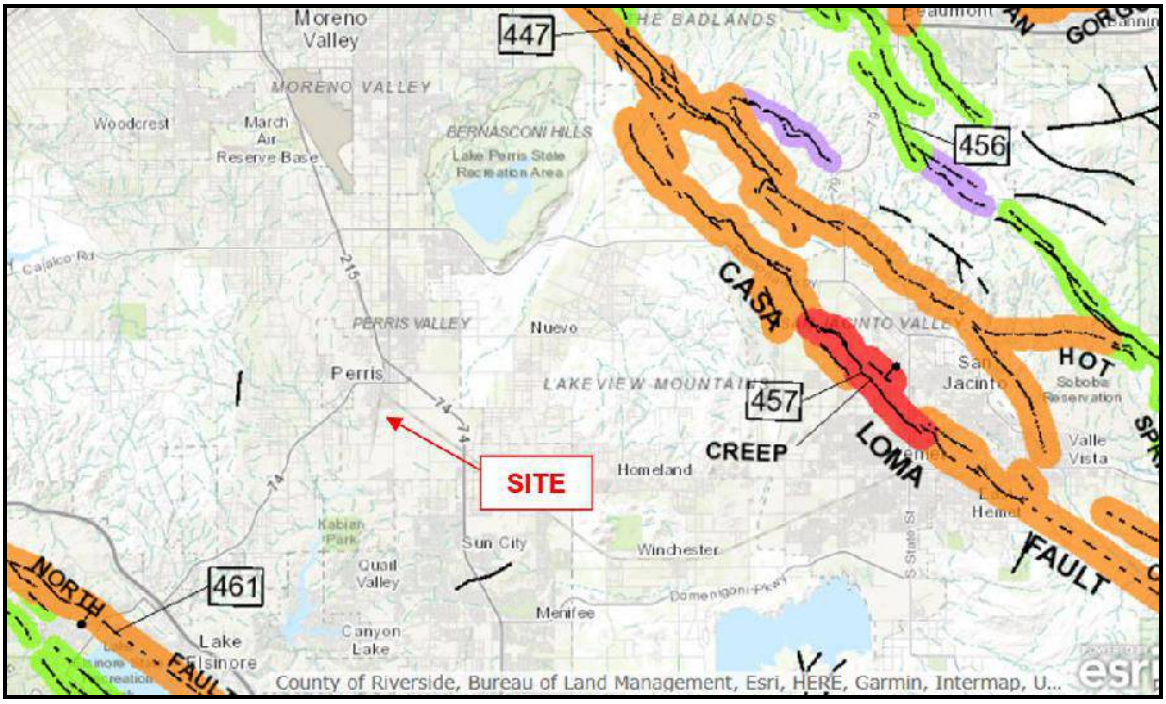
Historical groundwater records compiled by the State of California Division of Water Resources (1922) reference State Well 5S3W6D, described as having been located 2,200 feet to the southeast of the project site. The reported depth to groundwater on July 24, 1922, was 22.2 feet.

On the bases of the historical groundwater records reviewed, we have assumed the historical high groundwater level beneath the site is about 30 feet below the existing ground surface.

Faulting: There are at least 38 major late Quaternary active/potentially active faults that are within a 100-kilometer radius of the site (Blake, 2000). The site is not located within a State of California "Alquist-Priolo Earthquake Fault Zone" for fault rupture hazard (Hart and Bryant, 2007) or a Riverside County mapped fault zone.

Figure 4 presents a portion of the 2010 Fault Activity Map of California (CGS, 2010) depicting the site location and mapped faults in the vicinity. This map indicates that no active faults are present on the site, or trend toward the site.

Figure 4: 2010 Fault Activity Map of California (CGS, 2010)



Fault along which historic (last 200 years) displacement has occurred

Holocene fault displacement (during past 11,700 years) without historic record.

Late Quaternary fault displacement (during past 700,000 years).

Our evaluation of the potential for surface fault rupture at this site included an examination of eight stereo pairs of vertical black and white aerial photographs dating from 1962 to 2010 (see References for a listing) to aid in assessing the geologic and geomorphic characteristics with respect to the site and vicinity. The photogeologic analysis did not reveal indicators suggestive of active fault-related features. This included the lack of photolineations and/or no consistent tonal variations across the site, or trending toward the site.

Our review indicates that no documented active faults traverse toward the subject site, based on published literature. No surficial indications or geomorphic features were observed within the aerial photographs or field reconnaissance that are suggestive of active faulting.

As tabulated by Blake (2000) and based on our review of the USGS 2008 National Seismic Hazard Maps - Source Parameters (USGS, 2008), the major faults influencing the site include the Elsinore (Glen Ivy and Temecula segments) and the San Jacinto faults (San Jacinto Valley and San Bernardino Valley segments). The Elsinore fault zone is a major dextral shear system, parallel to the southern San Andreas fault, that accommodates about 5 mm/yr of the Pacific-North American Plate boundary slip. The northern elements of the fault zone, the Chino and Whittier faults, bound the Puente Hills, an uplifted block of Tertiary sediments. The Glen Ivy section forms the northeast boundary of the Santa Ana Mountains and, together with the Temecula section, forms the Elsinore trough (Treiman, 1998).

The nearest known active fault is the Glen Ivy North fault, which is a segment of the Elsinore Fault Zone system that extends from the Los Angeles Basin to the north into Mexico to the south. The Glen Ivy North fault is located approximately 15 kilometers to the southwest of the project site. This fault is right-lateral, strike-slip fault capable of producing an earthquake with an estimated maximum moment magnitude of M_W 6.8. The Temecula segment of the Elsinore Fault Zone system, located approximately 17.6 kilometers to the southwest of the project site, is also a right-lateral, strike-slip fault capable of producing an earthquake with an estimated maximum moment magnitude of M_W 7.0 (U.S.G.S., 2008).

The San Jacinto fault (San Jacinto Valley segment, USGS, 2008) is a right-lateral, strike-slip fault, approximately 43 kilometers in length, with an estimated maximum moment magnitude (M_w) earthquake of M_w7.0. The approximate distances to the faults and published maximum earthquake magnitudes are presented in Table 1:

Table 1: Major Fault Parameters (USGS, 2008)

Fault Zone	Approximate Distance (km)	Earthquake Magnitude (M_w)
Elsinore - Glen Ivy	15.1	6.8
Elsinore - Temecula	17.6	7.0
San Jacinto - San Jacinto Valley	16.4	7.0
San Jacinto - Anza	28.3	7.2

Seismic Parameters: The site coordinates (WGS 84) are 33.7676°N / -117.2291°W. The USGS web application, U.S. Seismic Design Maps, was used to evaluate the seismic parameters for this project. Table 2 summarizes site-specific design criteria obtained from the 2016 California Building Code (CBC), which is based on ASCE 7-10. Our evaluation of the site class is based on the discussion in Section 1613.3.2 of the 2016 CBC and Table 20.3-1 of ASCE 7-10. The values presented in Table 2 are for the risk-targeted maximum considered earthquake (MCER).

Table 2: 2016 CBC Seismic Design Parameters

Seismic Parameter	2016 CBC / ASCE 7-10 Reference	Value
Site Class	- - - / Table 20.3-1	D
S_s - Mapped Spectral Acceleration for Short Period	Fig. 1613.3.1(1) / Figure 22-1	1.500 g
S_1 - Mapped Spectral Acceleration for 1-sec Period	Fig. 1613.3.1(2) / Figure 22-2	0.600 g
F_a – Short Period Site Coefficient	Table 1613.3.3(1) / Table 11.4-1	1.0
F_V – Long Period Site Coefficient	Table 1613.3.3(2) / Table 11.4-2	1.5
SM_S – Maximum Considered Earthquake Spectral Response Acceleration, 5% damped, 0.2-sec period, adjusted for Site Class	Eq. 16-37 / Eq. 11.4-1	1.500 g
SM_1 - Maximum Considered Earthquake Spectral Response Acceleration, 5% damped, 1-sec period, adjusted for Site Class	Eq. 16-38 / Eq. 11.4-2	0.900 g
SD_S - Design Earthquake Spectral Response Acceleration, 5% damped, 0.2-sec period	Eq. 16-39 / Eq. 11.4-3	1.000 g
SD_1 - Design Earthquake Spectral Response Acceleration, 5% damped, 1-sec period	Eq. 16-40 / Eq. 11.4-4	0.600 g
MCE_G PGA – Maximum Considered Earthquake Geometric Mean for Site Class B	- - - / Figure 22-7	0.500
PGA_M – MCE_GPGA adjusted for Site Class	- - - / Eq. 11.8-1	0.5 g
Seismic Design Category	Section 11.6	D

Secondary Seismic Hazards: The primary geologic hazard affecting the project is that of ground shaking. Secondary permanent or transient seismic hazards generally associated with severe ground shaking during an earthquake include, but are not necessarily limited to, ground rupture, liquefaction, seiches or tsunamis, landsliding, rockfalls and debris flows. These are discussed below:

Ground Rupture: Ground rupture is generally considered most likely to occur along pre-existing faults. No known faults are known to traverse the subject site. On this basis, it is our opinion that the potential for fault rupture at the site is low.

Liquefaction and Seismically-Induced Settlement: In general, liquefaction is a phenomenon that occurs where there is a loss of strength or stiffness in the soils that can result in the settlement of buildings, ground failure, or other hazards. The main factors contributing to this phenomenon are: 1) cohesionless, granular soils having relatively low density (usually of Holocene age); 2) shallow ground water (generally less than 50 feet); and 3) moderate to high seismic ground shaking. Due to the presence of medium dense to very dense older alluvial soils at the site, the potential for liquefaction and seismically induced settlement is negligible.

Seiches/Tsunamis: A seiche is a standing wave in an enclosed or partially enclosed body of water. In order for a seiche to form, the body of water needs to be at least partially bounded, allowing the formation of the standing wave. Tsunamis are very large ocean waves that are caused by an underwater earth-quake or volcanic eruption, often causing extreme destruction when they strike land.

There are no bodies of water on or adjacent to the project site. Based on the distance to large, open bodies of water and the elevation of the site with respect to sea level, it is our opinion that the potential for seiches/tsunamis does not present a hazard to this project.

Landsliding: Due to the relatively low-lying relief of the site and adjacent areas, the potential for landsliding due to seismic shaking is considered very low.

Rockfalls: Since no large rock outcrops are present at or adjacent to the site, the possibility of rockfalls during seismic shaking is nil.

Debris Flows: Debris flows are composed of a slurry-like mass of liquefied debris (ranging up to boulder size) that moves downhill under the force of gravity.

Such slurries are dense enough to support very large particles but not solid enough to resist flowing downhill. Debris flows are most common in steep mountain canyons when a mass of mud and debris becomes saturated during a heavy rainstorm and suddenly begins to flow down the canyons (Prothero & Schwab, 1996). Based on the location of the site and the relatively planar topography of the property up-gradient of site, the hazard of debris flow should be considered low.

Other Geologic Hazards: There are other geologic hazards not necessarily associated with seismic activity that occur statewide. These hazards include, but are not limited to; natural hazardous materials (methane gas, hydrogen-sulfide gas, tar seeps); Radon-222 gas; and naturally occurring asbestos. Of these hazards, there are none that appear to impact the site.

SUBSURFACE CONDITIONS

The field and laboratory exploration and testing indicate that the site is underlain by alluvial soils comprised predominately of fine- to coarse-grained layers of clayey sand (SC) and silty sand (SM) over granitic bedrock to at least a depth of 50 feet. In borings B-02 and B-04, granitic bedrock was encountered at a depth of ±37 feet below the existing ground surface, immediately below a layer of clay (CL). In general, the soil encountered was medium to dense and moderately to slightly cemented.

Groundwater was encountered within our exploratory borings at depths of approximately 36 to 38 feet below the existing ground surface. Historical groundwater data reviewed for this project indicates that the depth to groundwater has historically been on the order of ±30 feet below the existing ground surface.

Laboratory testing indicates that the near surface soils are expansive. Expansion index (EI) values of 26 and 42 are indicated by the results of laboratory testing on representative soil samples.

Analytical testing indicates the concentration of sulfates is very low with respect to sulfate attack on concrete. Chloride concentrations in the tested samples were 60 parts per million. The soil is slightly to moderately alkaline with a pH value ranging from 7.8 to 8.1. Saturated resistivity values ranged from 1,500 to 3,600 ohm-cm.

CONCLUSIONS AND RECOMMENDATIONS

On the basis of our field and laboratory exploration and testing, the proposed construction is feasible from a geotechnical engineering standpoint. Existing site soils should be suitable for providing foundation support with appropriate compaction, as recommended herein. The primary issue requiring mitigation is the presence of expansive soils. Expansive soil design criteria are recommended for concrete slabs-on-grade.

Analytical testing indicates sulfate concentrations are very low. Per ACI 318, Table 19.3.1.1, the soil can be classified as Class S0 with respect to sulfate exposure. Chloride concentrations are also low. Saturated resistivity values indicate that the site soils are moderately corrosive to corrosive with respect to buried metal. This should be addressed by a qualified corrosion engineer for elements of construction that may be subject to corrosion.

The following paragraphs present more detailed design criteria which have been developed on the basis of our field and laboratory exploration and testing.

Foundation Design: Foundations for the proposed development may consist of shallow spread footings with slab-on-grade floors. For footing design, we recommend an allowable soil bearing capacity of 1,500 pounds per square foot. This value may be increased by ⅓ for short-term transient wind and seismic loads.

Conventional spread foundations should have a minimum width of 12 inches and should be founded a minimum depth of 12 inches beneath the lowest adjacent final grade.

Building footings should be supported by at least 12 inches of compacted fill over suitably dense alluvial soil.

Static settlement of foundations properly designed and constructed as recommended herein is expected to be less than one inch total. Differential settlement between foundations of similar size and load is expected to be less than ½-inch in 40 feet horizontal.

The site is underlain by expansive soil. The 2016 CBC requires that slab-on-grade foundations on expansive soils be designed in accordance with WRI/CRSI Design of Slab-on-Ground Foundations (1981) or PTI Standard Requirements for Analysis of Shallow Concrete Foundations on Expansive Soils (2012). Recommended design

parameters for use with these methods are presented in the "Concrete Slabs-on-Grade" section of this report.

If conventional slabs-on grade are utilized, they should be supported by at least three feet of imported non-expansive soil.

Lateral Design: Resistance to lateral loads will be provided by a combination of friction acting at the base of the slab or foundation and passive earth pressure. A coefficient of friction of 0.40 between soil and concrete may be used with dead load forces only. A passive earth pressure of 230 psf, per foot of depth, may be used for the sides of footings poured against recompacted or dense native material. These values may be increased by 33 percent to provide for lateral loads of short duration such as those caused by wind or seismic forces. Passive earth pressure should be ignored within the upper one foot except where confined as beneath a floor slab, for example.

Excavation and Trench Wall Stability: All excavations should be configured in accordance with the requirements of CalOSHA. We recommend the soils be classified as Type C. The classification of the soil and the shoring and/or slope configuration should be the responsibility of the contractor on the basis of the excavation depth and the soil encountered. The contractor should have a "competent person" onsite for the purpose of assuring safety within and about all construction excavations.

Retaining Walls: Retaining walls may be necessary during construction and/or landscaping. Retaining walls backfilled with on-site soil may be designed for an active earth pressure equivalent to that exerted by a fluid weighing not less than 45 pounds per cubic foot. For walls that are restrained, an "at-rest" lateral earth equivalent fluid pressure of 70 pounds per cubic foot should be used, with the resultant applied at mid-height.

Concrete Slabs-on-Grade: Our exploratory borings and laboratory testing indicate that potentially expansive soils are present throughout the project site and that expansive soil design criteria should be implemented for foundations and concrete slabs-on-grade. *If conventional slabs-on grade are utilized, they should be supported by at least three feet of imported non-expansive soil.*

The 2016 CBC requires that slab-on-grade foundations on expansive soils be designed in accordance with ***WRI/CRSI Design of Slab-on-Ground Foundations (1981)*** or ***PTI Standard Requirements for Analysis of Shallow Concrete Foundations on Expansive Soils (2012)***. The following table presents the design parameters for the WRI method:

Table 3: WRI Parameters

Parameter	Reference	Value
C_O	WRI Figure 5	2.0
C_S	WRI Figure 4	1.0
C_W	WRI Figure 14	15
Effective PI	Laboratory Testing	11
1-C	WRI Figure 15	0.0

PTI design criteria for the design of post-tensioned slabs are presented in the following table:

Table 4: PTI Parameters

Parameter	Reference	Value
Equilibrium suction (pF)	Figure 5.11	4.0
Thornthwaite Index	Figure A3	-30
e_m edge lift	Section 5.10	5.0 ft.
y_m edge lift	Table 5.2 (a)	0.6 in.
e_m center lift	Section 5.10	9.0 ft.
y_m center lift	Table 5.2 (a)	0.2 in.

All concrete slabs-on-grade should have a minimum thickness of four inches. During final grading and prior to the placement of concrete, all surfaces to receive concrete slabs-on-grade should be compacted to maintain a minimum compacted fill thickness of 12 inches.

Load bearing slabs may be designed using a modulus of subgrade reaction not exceeding 125 pounds per square inch per inch.

Slabs that are designed and constructed per the provisions of the American Concrete Institute (ACI) as a minimum will perform much better and will be more pleasing in appearance. Shrinkage of concrete should be anticipated. This will result in cracks in all concrete slabs-on-grade. Shrinkage cracks may be directed to saw-cut "control joints" spaced on the basis of slab thickness and reinforcement. ACI typically recommends control joint spacing in unreinforced concrete at maximum intervals equal to the slab thickness times 24. A level subgrade is also an important element in achieving some “control” in the locations of shrinkage cracks. Control joints should be cut immediately following the finishing process and prior to the placement of the curing cover or membrane. Control joints that are cut on the day following the concrete placement are generally ineffective. The placement of reinforcing steel will help in reducing crack width and propagation as-well-as providing for an increase in the control

joint spacing. The use of welded wire mesh has typically been observed to be of limited value due to difficulties and lack of care in maintaining the level of the steel in the concrete during placement. The addition of water to the mix to enhance placement and workability frequently results in an excessive water-cement ratio that weakens the concrete, increases drying times and results in more cracking due to concrete shrinkage during the initial cure.

Where slabs are to receive moisture sensitive floor coverings, we recommend the use of a vapor retarder. Vapor retarders should have a minimum thickness of 10-mil unless otherwise specified. It is possible that the retarders will be exposed to equipment loads such as ready-mix trucks, buggies, laser screeds, etc. In such cases, the thickness should be increased to at least 15-mil. Vapor retarders should be placed between two 2-inch thick layers of sand to reduce the potential of punctures and to aid in the curing process. In lieu of this, the concrete may be placed directly upon the vapor retarder but should be designed with reinforcement to offset additional curling stresses. Seams and holes made for underground utilities should be properly sealed per the recommendations of the manufacturer.

Vapor retarders are a common method of reducing the migration of moisture through the slab. They will not prevent all moisture migration through slabs nor will they prohibit the formation of mold or other moisture related problems. For moisture sensitive floor coverings, an expert in that field should be consulted to properly design a vapor retarder suitable for the specific application.

If concrete is to be placed on a dry absorptive subgrade in hot and dry weather, the subgrade should be dampened but not to a point that there is freestanding water prior to placement. The formwork and reinforcement should also be dampened.

General Site Grading: All grading should be performed per the applicable provisions of the 2016 California Building Code. The following recommendations have been developed on the basis of our field and laboratory testing:

1. **Clearing and Grubbing:** All building, slab and pavement areas and all surfaces to receive compacted fill should be cleared of existing loose soil, vegetation, tree roots, artificial fill, debris, and other unsuitable materials. Within the building pad areas, we recommend a minimum over-excavation depth of one (1) foot below the footing bottom elevations. Building pad preparation recommendations are detailed below under Item 4, “Preparation of Building Pad”.

   Abandoned underground utility lines should be traced out and completely removed from the site. Each end of the abandoned utility line should be securely

capped at the entrance and exit to the site to prevent any water from entering the site. Soil loosened due to the removal of trees should be removed and replaced as controlled compacted fill under the direction of the geotechnical engineer. A search should be made for former septic systems, including septic tanks, seepage pits and or leachlines. These should be removed and backfilled at the direction of the geotechnical engineer.

2. **Preparation of Surfaces to Receive Compacted Fill:** All surfaces to receive compacted fill should be subjected to compaction testing prior to processing. Testing should indicate a relative compaction of at least 85 percent within the unprocessed native soils. If roots or other deleterious materials are encountered or if the relative compaction fails to meet the acceptance criterion, additional overexcavation may be required until satisfactory conditions are encountered. Upon approval, surfaces to receive fill should be scarified, brought to near optimum moisture content, and compacted to a minimum of 90 percent relative compaction.

3. **Placement of Compacted Fill:** Fill materials consisting of on-site soils or approved imported granular soils should be spread in shallow lifts and compacted at near optimum moisture content to a minimum of 90 percent relative compaction.

4. **Preparation of Building Area:** The building area should be over-excavated to a depth of at least two (2) feet below existing or finish grade, or one (1) foot below the bottom of the deepest footings, whichever is deeper. Over-excavation should extend laterally for at least five (5) feet outside of exterior building foundation lines.

5. **Preparation of Slab and Paving Areas:** During final grading and immediately prior to the placement of concrete or a base course, all surfaces to receive asphalt concrete paving or concrete slabs-on-grade should be processed and tested to assure compaction for a depth of at least of 12 inches. This may be accomplished by a combination of overexcavation, scarification and recompaction of the surface, and replacement of the excavated material as controlled compacted fill. Compaction of slab areas should be to a minimum of 90 percent relative compaction. Compaction within proposed pavement areas should be to a minimum of 95 percent relative compaction for both the subgrade and base course.

6. **Utility Trench Backfill:** Utility trench backfill consisting of the on-site soil types should be placed by mechanical compaction to a minimum of 90 percent relative

compaction. This is with the exception of the upper 12 inches under pavement areas where the minimum relative compaction should be 95 percent. Jetting of the native soils is not recommended.

7. **Testing and Observation:** During grading, tests and observations should be performed by a representative of this firm to verify that the grading is performed per the project specifications. Field density testing should be performed per the current ASTM D1556 or ASTM D6938 test methods. The minimum acceptable degree of compaction should be 90 percent of the maximum dry density, based on ASTM D1557, except where superseded by more stringent requirements, such as beneath pavement. Where testing indicates insufficient density, additional compactive effort should be applied until retesting indicates satisfactory compaction.

GENERAL

The findings and recommendations presented in this report are based upon the soil conditions encountered at an accessible location adjacent to the proposed structure. Should conditions be encountered during grading that appear to be different than those indicated by this report, this office should be notified.

This report was prepared prior to the preparation of a grading plan for the project. We recommend that a pre-job conference be held on the site prior to the initiation of site grading. The purpose of this meeting will be to assure a complete understanding of the recommendations presented in this report as they apply to the actual grading performed.

This report was prepared for El Paso Oil, Inc. for their use in the design of the proposed development. This report may only be used by El Paso Oil, Inc. for this purpose. The use of this report by parties other than El Paso Oil, Inc. or for other purposes is not authorized without written permission by Inland Foundation Engineering, Inc. Inland Foundation Engineering, Inc. will not be liable for any projects connected with the unauthorized use of this report.

The recommendations of this report are considered to be preliminary. The final design parameters may only be determined or confirmed at the completion of site grading on the basis of observations made during the site grading operation. To this extent, this report is not considered to be complete until the completion of both the design process and the site preparation.

LIMITATIONS

The findings and recommendations of this report are based upon an interpolation of soil conditions between test locations. It is possible that conditions may be encountered that are different than those indicated in this report. Should such conditions be encountered during construction, our office should be notified in order to determine if revisions or retesting are warranted.

Evaluation of hazardous waste was not within the scope of services provided. The information in this report represents professional opinions that have been developed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical consultants practicing in this or similar localities. No other warranty, either expressed or implied, is made as to the professional advice included in this report.

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APPENDIX A

APPENDIX A

FIELD EXPLORATION

For our field exploration, four exploratory borings were excavated by means of a truck mounted rotary auger rig at the approximate locations shown on Figure No. A-7. The materials encountered in the borings were logged on the site by a staff geologist. The boring logs are presented on Figure Nos. A-3 through A-6.

Representative soil samples were obtained within our borings by driving 18-inch long, thin-walled steel penetration samplers with successive 30-inch drops of a 140-pound hammer. The number of blows required to achieve each six inches of penetration were recorded on our boring logs and used for estimating the relative consistency of the subsoils. Two different samplers were used. The first sampler used was a Standard Penetration Test sampler (SPT) for which published correlations relating the number of hammer blows to the strength of the soil is available. The second sampler type was a modified California split barrel sampler, which is larger in diameter and lined with 2.41-inch diameter brass sample rings. Soil samples were placed in moisture sealed containers and transported to our laboratory. Laboratory test results are presented in Appendix B.

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D2487)

PRIMARY DIVISIONS			GROUP SYMBOLS		SECONDARY DIVISIONS
COARSE GRAINED SOILS – MORE THAN HALF OF MATERIALS IS LARGER THAN #200 SIEVE SIZE	GRAVELS – MORE THAN HALF OF COARSE FRACTION IS LARGER THAN #4 SIEVE	CLEAN GRAVELS (LESS THAN) 5% FINES	GW		WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			GP		POORLY GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVEL WITH FINES	GM		SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			GC		CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS – MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN #4 SIEVE	CLEAN SANDS (LESS THAN) 5% FINES	SW		WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP		POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES	SM		SILTY SANDS, SAND-SILT MIXTURES
			SC		CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS – MORE THAN HALF OF MATERIALS IS SMALLER THAN #200 SIEVE SIZE	SILTS AND CLAYS – LIQUID LIMIT IS LESS THAN 50		ML		INORGANIC SILTS, VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS
			CL		INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL		ORGANIC SILTS AND ORGANIC SILT-CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS – LIQUID LIMIT IS GREATER THAN 50		MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDS OR SILTS, ELASTIC SILTS
			CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH		ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
	HIGHLY ORGANIC SOILS		PT		PEAT, MUCK AND OTHER HIGHLY ORGANIC SOILS
TYPICAL FORMATIONAL MATERIALS	SANDSTONES		SS		
	SILTSTONES		SH		
	CLAYSTONES		CS		
	LIMESTONES		LS		
	SHALE		SL		

CONSISTENCY CRITERIA BASES ON FIELD TESTS

RELATIVE DENSITY – COARSE – GRAIN SOIL

RELATIVE DENSITY	SPT * (# BLOWS/FT)	RELATIVE DENSITY (%)
VERY LOOSE	<4	0-15
LOOSE	4-10	15-35
MEDIUM DENSE	10-30	35-65
DENSE	30-50	65-85
VERY DENSE	>50	85-100

CONSISTENCY – FINE-GRAIN SOIL

		TORVANE	POCKET ** PENETROMETER
CONSISTENCY	SPT* (# BLOWS/FT)	UNDRAINED SHEAR STRENGTH (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)
Very Soft	<2	<0.13	<0.25
Soft	2-4	0.13-0.25	0.25-0.5
Medium Stiff	4-8	0.25-0.5	0.5-1.0
Stiff	8-15	0.5-1.0	1.0-2.0
Very Stiff	15-30	1.0-2.0	2.0-4.0
Hard	>30	>2.0	>4.0

* NUMBER OF BLOWS OF 140 POUND HAMMER FALLING 30 INCHES TO DRIVE A 2 INCH O.D. (1 3/8 INCH I.D.) SPLIT BARREL SAMPLER (ASTM -1586 STANDARD PENETRATION TEST)

** UNCONFINED COMPRESSIVE STRENGTH IN TONS/SQ.FT. READ FROM POCKET PENETROMETER

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
DRY	Absence of moisture, dusty, dry to the touch
MOIST	Damp but no visible water
WET	Visible free water, usually soil is below water table

CEMENTATION

DESCRIPTION	FIELD TEST
Weakly	Crumbled or breaks with handling or slight finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumble or break with finger pressure

LOG OF BORING B-01

DRILLING RIG	**CME-75**	DATE DRILLED	**6/11/18**	HAMMER TYPE	**Auto-Trip**
DRILLING METHOD	**Rotary Auger**			HAMMER WEIGHT	**140-lb.**
LOGGED BY	**HM**			HAMMER DROP	**30-inches**
GROUND ELEVATION	**+/- 1433 ft**			BORING DIAMETER	**8-inches**

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	BULK SAMPLE	DRIVE SAMPLE	SAMPLE TYPE	BLOW COUNTS /6"	MOISTURE (%)	DRY UNIT WT. (pcf)
0			This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered and is representative of interpretations made during drilling. Contrasting data derived from laboratory analysis may not be reflected in these representations.						
	SC		**CLAYEY SAND,** with silt, fine- to coarse-grained, brown (10YR 4/3), dry to slightly moist, dense, moderately cemented.			GB			
						SS	20 25	5	112
						SS	20 50	7	126
5									
	SC		**CLAYEY SAND,** with silt, fine- to coarse-grained, brown (10YR 4/3) to yellowish-brown (10YR 5/4), slightly moist, dense, slightly cemented.			SS	10 50/5"	13	123
10						SS	12 12	7	119
						SS	50	8	
15									
	SC					SPT	21 21	9	
20									
						SPT	11 20	9	
25									
						SPT	22 45	11	
			End of boring at 26.5 feet. No groundwater encountered. Backfilled with native soils.						

Inland Foundation Engineering, Inc.

CLIENT	**El Paso Oil, Inc.**
PROJECT NAME	**Geotechnical Investigation**
PROJECT LOCATION	**Malbert Street** **Perris, CA**
PROJECT NUMBER	**E137-001**

FIGURE NO. A-3

IFE BORING - GINT STD US LAB.GDT - 9/7/18 10:21 - P:\E137\001\GINT.GPJ

LOG OF BORING B-02

DRILLING RIG	**CME-75**	DATE DRILLED	**6/11/18**	HAMMER TYPE	**Auto-Trip**
DRILLING METHOD	**Rotary Auger**			HAMMER WEIGHT	**140-lb.**
LOGGED BY	**HM**			HAMMER DROP	**30-inches**
GROUND ELEVATION	**+/- 1433.5 ft**			BORING DIAMETER	**8-inches**

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	BULK SAMPLE	DRIVE SAMPLE	SAMPLE TYPE	BLOW COUNTS /6"	MOISTURE (%)	DRY UNIT WT. (pcf)
0			This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered and is representative of interpretations made during drilling. Contrasting data derived from laboratory analysis may not be reflected in these representations.						
	SC		**CLAYEY SAND,** with silt, fine- to coarse-grained, brown (10YR 4/3), dry to slightly moist, dense, moderately cemented.			GB			
						SS	24 50	5	126
5						SS	22 32	7	132
						SS	23 50	10	131
10			**CLAYEY SAND,** with silt, fine- to coarse-grained, brown (10YR 4/3) to dark yellowish-brown (10YR 4/4), slightly moist, dense, slightly cemented.			SS	40 50	11	126
15						SPT	17 20	10	
20	SC					SPT	20 18	8	
25						SPT	31 50	12	
30						SPT	8 10	14	
35	CL		**CLAY,** trace silt, olive (2.5Y 4/3), moist, hard.			SPT	18 50	18	
40			▼ **GRANITIC BEDROCK,** gray (2.5Y 6/1), moist to wet, very dense, moderately weathered.			SPT	50/4"	6	
			End of boring at 40.3 feet. Groundwater encountered at 37.7 feet. Backfilled with native soils.						

LOG OF BORING B-03

DRILLING RIG	**CME-75**	DATE DRILLED	**6/11/18**	HAMMER TYPE	**Auto-Trip**
DRILLING METHOD	**Rotary Auger**			HAMMER WEIGHT	**140-lb.**
LOGGED BY	**HM**			HAMMER DROP	**30-inches**
GROUND ELEVATION	**+/- 1434 ft**			BORING DIAMETER	**8-inches**

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	BULK SAMPLE	DRIVE SAMPLE	SAMPLE TYPE	BLOW COUNTS /6"	MOISTURE (%)	DRY UNIT WT. (pcf)
0			This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered and is representative of interpretations made during drilling. Contrasting data derived from laboratory analysis may not be reflected in these representations.						
	SC		**CLAYEY SAND,** with silt, fine- to coarse-grained, brown (10YR 4/3), dry to slightly moist, dense, moderately cemented.			GB			
						SS	40 44	6	126
						SS	50	8	109
5						SS	35 50/3"	8	111
	SC		**CLAYEY SAND,** with silt, fine- to coarse-grained, brown (10YR 4/3) to light olive-brown (2.5YR 5/3), slightly moist, dense, slightly cemented.			SS	17 22	5	112
10						SS	25 50	7	118
15						SPT	16 18	7	
20						SPT	16 18	7	
25						SPT	18 28	15	
			End of boring at 26.5 feet. No groundwater encountered. Backfilled with native soils.						

Inland Foundation Engineering, Inc.

CLIENT	**El Paso Oil, Inc.**
PROJECT NAME	**Geotechnical Investigation**
PROJECT LOCATION	**Malbert Street** **Perris, CA**
PROJECT NUMBER	**E137-001**

FIGURE NO. A-5

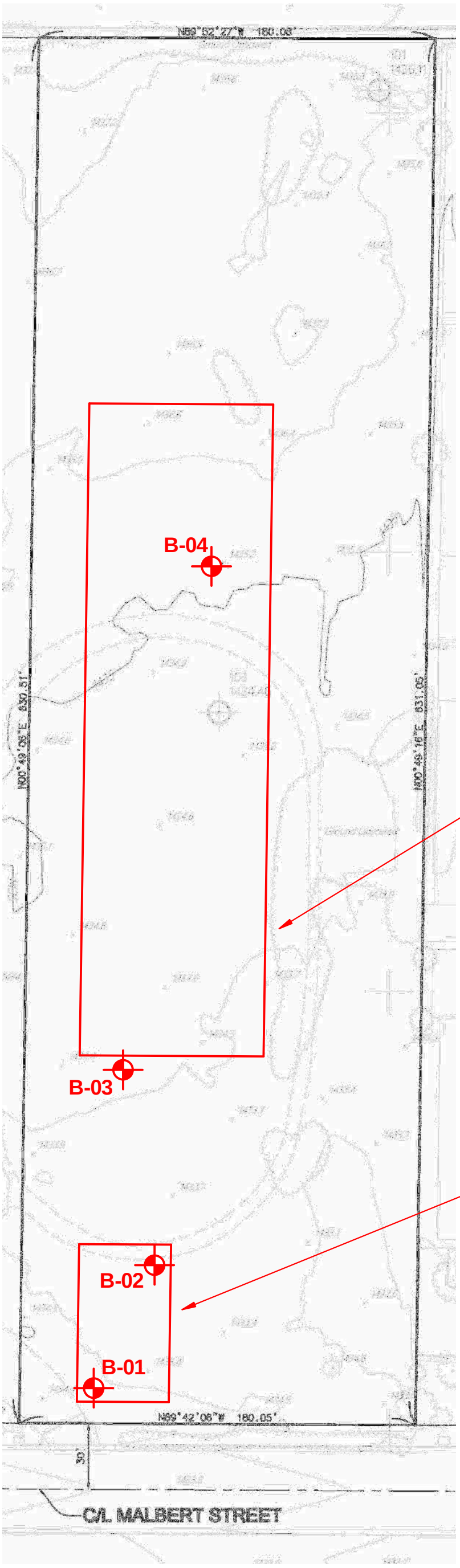
IFE BORING - GINT STD US LAB.GDT - 9/7/18 10:21 - P:\E137\001\GINT.GPJ

LOG OF BORING B-04

DRILLING RIG	**CME-75**	DATE DRILLED	**6/11/18**	HAMMER TYPE	**Auto-Trip**
DRILLING METHOD	**Rotary Auger**			HAMMER WEIGHT	**140-lb.**
LOGGED BY	**HM**			HAMMER DROP	**30-inches**
GROUND ELEVATION	**+/- 1435 ft**			BORING DIAMETER	**8-inches**

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	BULK SAMPLE	DRIVE SAMPLE	SAMPLE TYPE	BLOW COUNTS /6"	MOISTURE (%)	DRY UNIT WT. (pcf)
0			This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered and is representative of interpretations made during drilling. Contrasting data derived from laboratory analysis may not be reflected in these representations.						
			SILTY SAND, with clay, fine- to coarse-grained, brown (10YR 4/3), dry to slightly moist, dense, moderately cemented.			GB			
5	SM				☒	SS	30 50/4"	5	122
					☒	SS	50	3	118
			SILTY SAND, with clay, fine- to coarse-grained, dark brown (10YR 3/3), slightly moist, dense, slightly cemented.			GB			
10	SM				☒	SS	27 50	5	129
					☒	SS	31 36	8	131
15			**CLAYEY SAND,** with silt, fine- to coarse-grained, dark brown (10YR 3/3) to light olive-brown (2.5YR 5/3), slightly moist, dense, moderately to slightly cemented.		⧓	SPT	32 50	7	
20	SC				⧓	SPT	24 22	9	
25					⧓	SPT	25 50/5"	12	
30	SM		**SILTY SAND,** with clay, fine- to coarse-grained, dark brown (10YR 3/3), moist, dense, slightly cemented.		⧓	SPT	11 12	11	
35	CL		**CLAY,** trace silt, olive (2.5Y 4/3), moist, stiff.		⧓	SPT	9 10	24	
			▼ **GRANITIC BEDROCK,** gray (2.5Y 6/1), moist to wet, very dense, moderately weathered.		⧓	SPT	50/4"	6	
40									
45					⧓	SPT	50	13	
50					⧓	SPT	50/4"	10	
			End of boring at 50.3 feet. Groundwater encountered at 38 feet. Backfilled with native soils.						

SITE PLAN
PROPOSED COMMERCIAL DEVELOPMENT
NORTH OF MALBERT STREET
PERRIS, CALIFORNIA



LEGEND

= Approximate Location of Exploratory Boring

INLAND FOUNDATION ENGINEERING, INC.

1310 South Santa Fe Avenue
San Jacinto, California
(951) 654-1555 FAX (951) 654-0551

DRAWN BY: HM	JOB NO.: E137-001	
SCALE: 1" = 50'	DATE: September 2018	A-7

APPENDIX B

APPENDIX B

LABORATORY TESTING

Representative soil samples obtained from our borings were returned to our laboratory for additional observations and testing. Descriptions of the tests performed are provided below.

Unit Weight and Moisture Content: Each ring sample was weighed and measured to evaluate its unit weight. A small portion of each sample was then subjected to testing to evaluate its moisture content. This testing was performed per the current ASTM Standards D2937 and D2216. This was used in order to evaluate the dry density of the soil in its in-situ condition. The results of this testing are shown on the Boring Logs (Figure Nos. A-3 through A-6).

Maximum Density-Optimum Moisture Content: Two samples were selected for maximum density testing. This testing was performed per the current ASTM Standard D1557 test method A. The results of this testing are presented graphically on Figure No. B-4.

Sieve Analysis: Four soil samples were selected for sieve analysis testing. This testing consists of mechanical grain size analyses and was performed in accordance with ASTM D422. These tests provide information for developing classifications for the soil in accordance with the Unified Classification System. This classification system categorizes the soil into groups having similar engineering characteristics. The results of this testing are useful in detecting variations in the soil and in selecting samples for further testing. The results of this testing are presented on Figure No. B-5.

Atterberg Limits: Four samples were selected for Atterberg Limit testing in accordance with ASTM D4318. These tests provide information regarding soil plasticity and are also used for developing classifications for the soil in accordance with the Unified Classification System. The results are shown on Figure B-5.

Direct Shear Testing: One sample was selected for direct shear testing. This testing was performed per the current ASTM Standard D3080. This testing measures the shear strength of the soil under various normal pressures and is used in developing parameters for foundation design and lateral design. Testing was performed using test specimens which were saturated prior to testing. Testing was performed using a strain controlled test apparatus with normal pressures ranging from 500 to 2,500 pounds per square foot. The results of this testing are shown on Figure No. B-6.

Consolidation Testing: Two samples were selected for consolidation testing. This testing was performed per the current ASTM Standard D2435. For this test, relatively undisturbed samples were selected and trimmed into a one inch thick by 2.5-inch diameter consolidometer. The consolidometer was moisture sealed in order to preserve the moisture content of the sample during the initial stages of testing. Loads ranging from 325 to 20,800 pounds per square foot were applied progressively with the rate of settlement declining to a value of 0.0002 inches per hour prior to the application of each subsequent load. At a preselected load, water was introduced into the consolidometer in order to observe the potential for saturation collapse. The results of this testing are presented graphically on Figure No. B-7 and B-8.

Analytical Testing: Two samples were selected to evaluate the concentration of soluble sulfates and chlorides, pH level, and resistivity of and within the on-site soils. The following table presents the results of this testing.

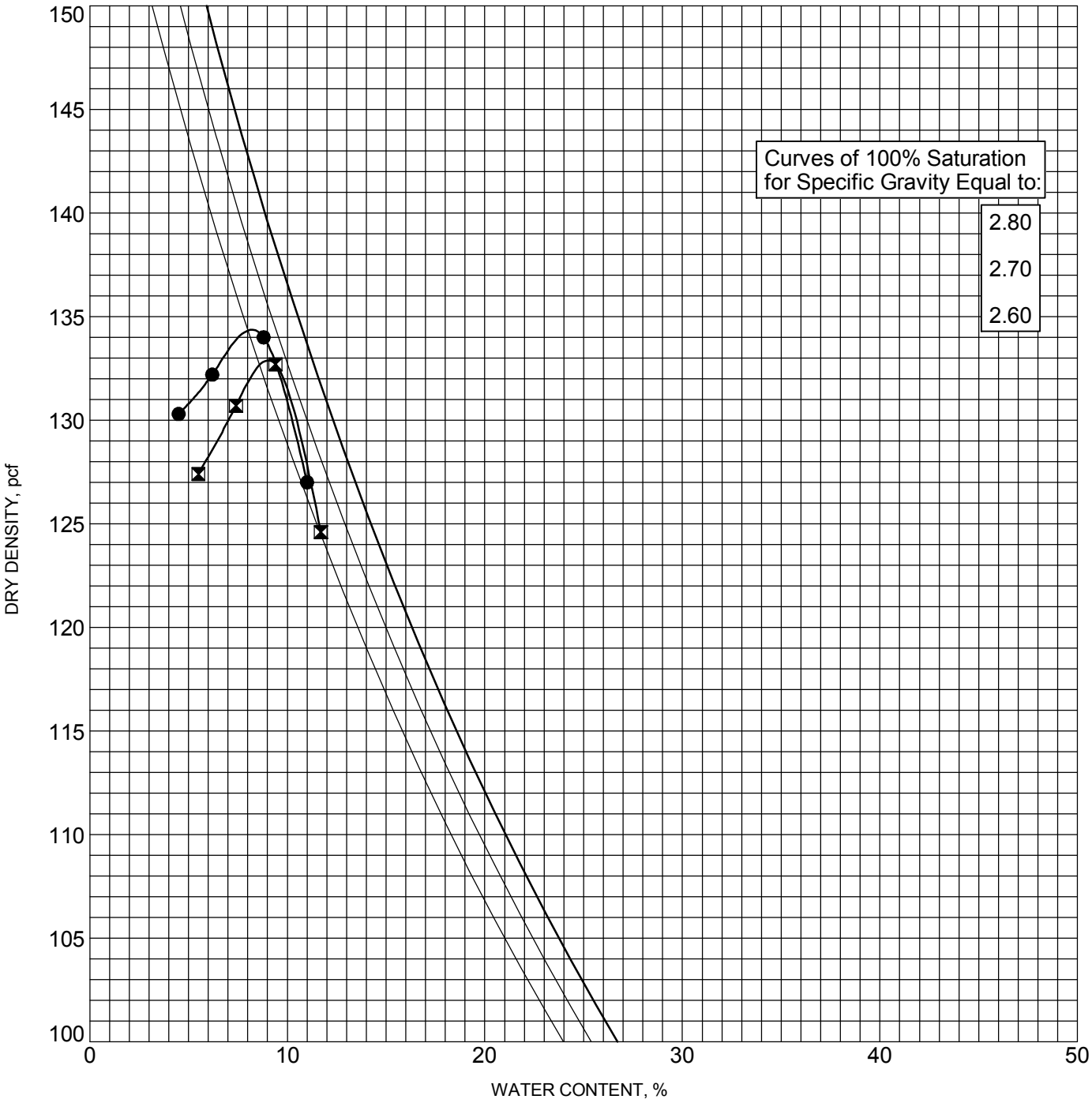
Sample Location	Sample Depth (ft.)	Water-Soluble Sulfates (%)	Chlorides (ppm)	Minimum Resistivity (ohm-cm)	pH
B-01	0.0-6.0	<0.001	60	3,600	7.8
B-03	0.0-8.0	<0.001	60	1,500	8.1

Expansion Index: Two samples were selected for expansion index testing per the current ASTM Standard D4829. This testing consists of remolding a 4-inch diameter by 1-inch thick test specimen to a moisture content and dry density corresponding to approximately 50 percent saturation. The sample is subjected to a surcharge of 144 pounds per square foot and allowed to reach equilibrium. At that point the specimens are inundated with distilled water. The linear expansion is then measured until complete. The following table presents the results of this testing.

Sample Location	Sample Depth (ft)	Initial Dry Density (pcf)	Initial Moisture Content (%)	Expansion Index	Expansion Class
B-01	0.0-6.0	114.3	8.5	26	Low
B-03	0.0-8.0	118.6	8.0	42	Low

GENERAL

All laboratory testing has been conducted in conformance with the applicable ASTM test methods by personnel trained and supervised in conformance with our QA/QC policy. Our test data only relates to the specific soils tested. Soil conditions typically vary and any significant variations should be reported to our laboratory for review and possible testing. The data presented in this report are for the use of El Paso Oil, Inc. only and may not be reproduced or used by others without written approval of Inland Foundation Engineering, Inc.



	BOREHOLE	DEPTH	Description of Materials	Max DD	Optimum WC
●	**B-01**	**0.0**	**CLAYEY SAND(SC)**	**134.4 PCF**	**8.3 %**
⊠	**B-03**	**0.0**	**CLAYEY SAND(SC)**	**132.9 PCF**	**9.1 %**

Inland Foundation Engineering, Inc.

MOISTURE-DENSITY CURVES (ASTM D1557)

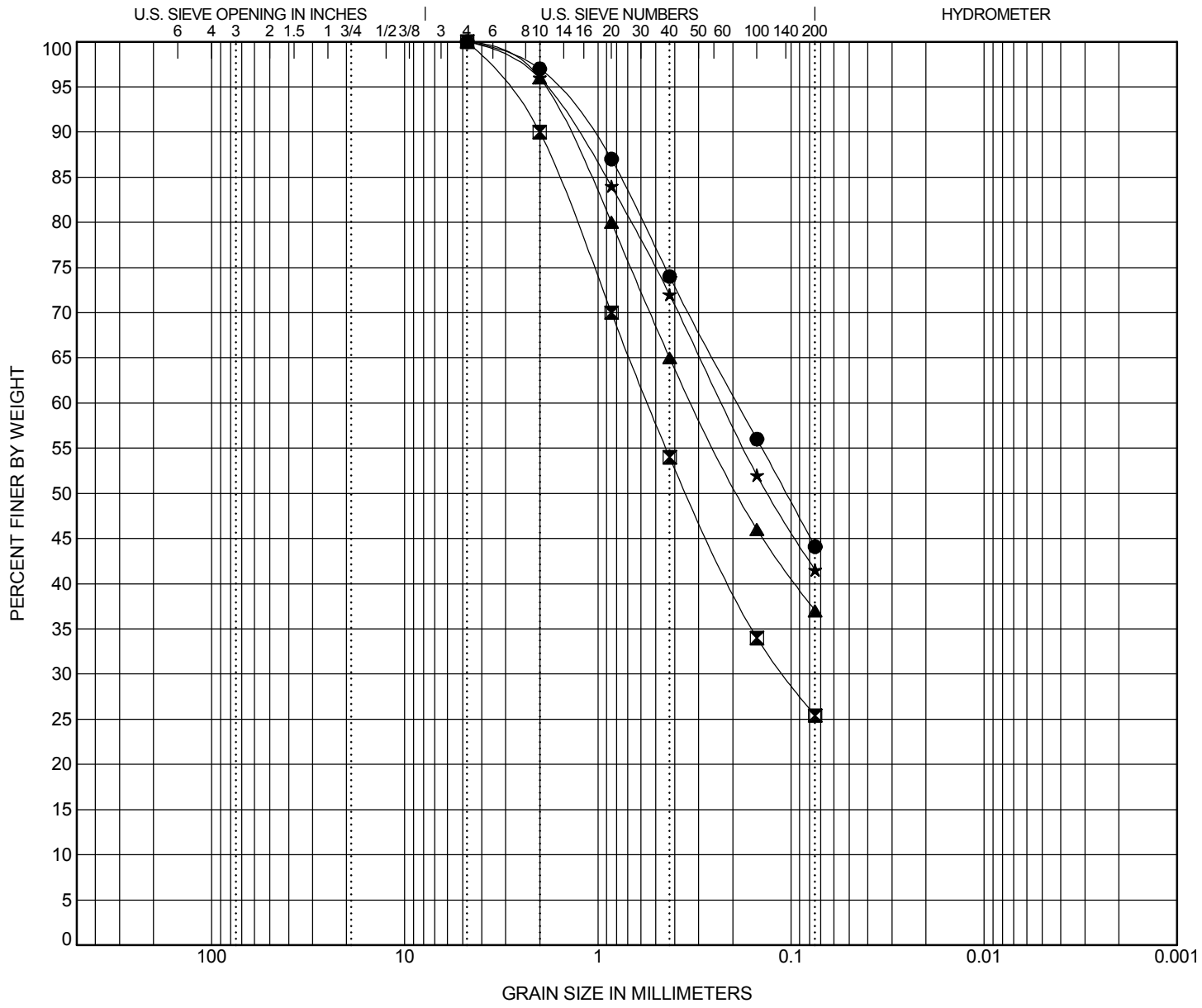
FIGURE NO. B-4

CLIENT El Paso Oil, Inc.

PROJECT NAME Geotechnical Investigation

PROJECT NUMBER E137-001

PROJECT LOCATION Malbert Street
Perris, CA



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**B-01**	**6.0**	**CLAYEY SAND(SC)**	**26**	**15**	**11**		
⊠	**B-02**	**2.0**	**CLAYEY SAND(SC)**	**26**	**15**	**11**		
▲	**B-02**	**8.0**	**CLAYEY SAND(SC)**	**29**	**18**	**11**		
★	**B-03**	**1.5**	**CLAYEY SAND(SC)**	**27**	**16**	**11**		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-01**	**6.0**	**4.75**	**0.189**			**0.0**	**55.9**	**44.1**	
⊠	**B-02**	**2.0**	**4.75**	**0.551**	**0.109**		**0.0**	**74.6**	**25.4**	
▲	**B-02**	**8.0**	**4.75**	**0.323**			**0.0**	**63.0**	**37.0**	
★	**B-03**	**1.5**	**4.75**	**0.228**			**0.0**	**58.5**	**41.5**	

GRADATION CURVES (ASTM D422, ASTM D4318)

Inland Foundation Engineering, Inc.

FIGURE NO. B-5

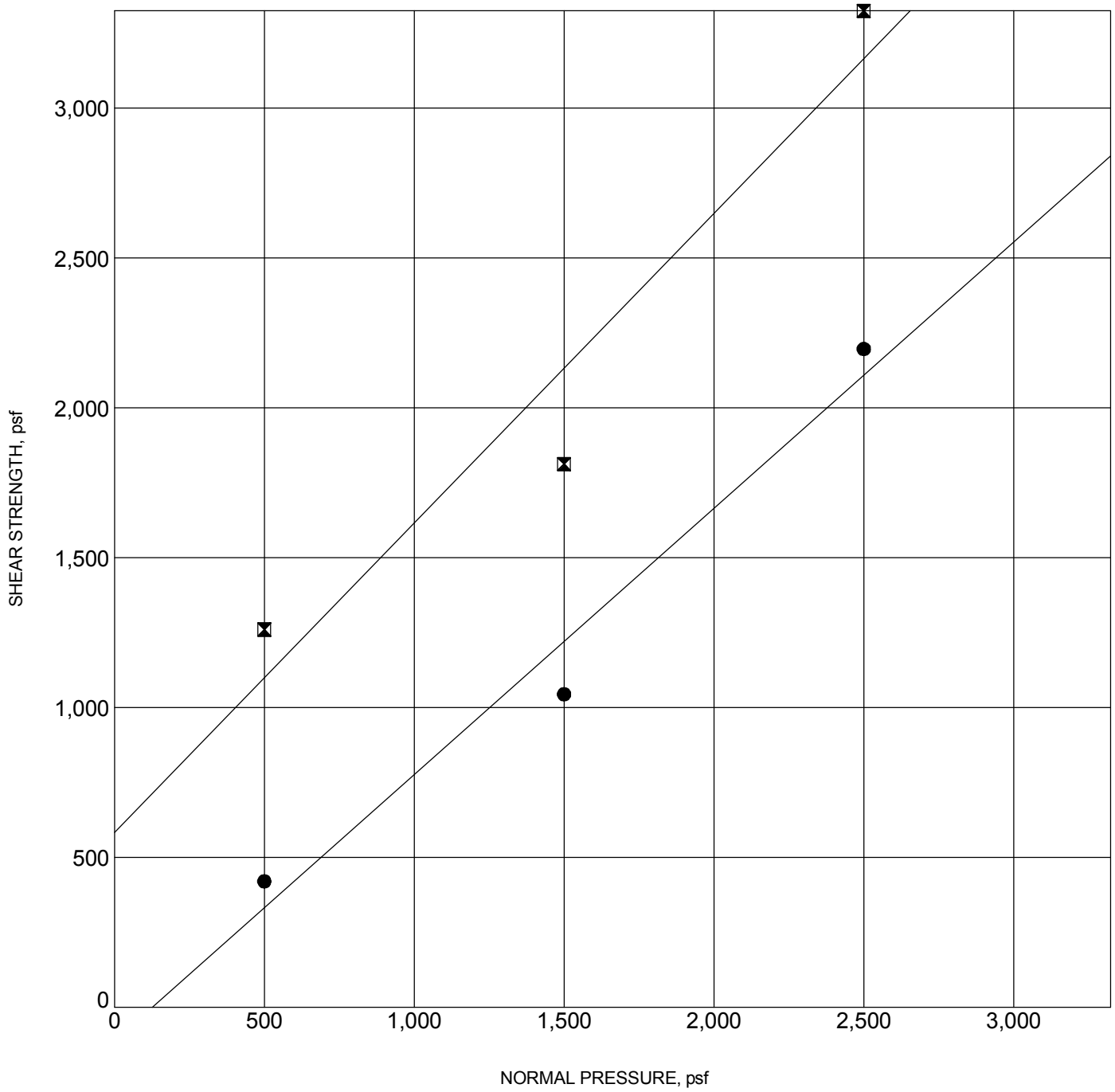
CLIENT El Paso Oil, Inc.

PROJECT NAME Geotechnical Investigation

PROJECT NUMBER E137-001

PROJECT LOCATION Malbert Street
Perris, CA

IFE SIEVE ANALYSIS - GINT STD US LAB.GDT - 9/7/18 10:24 - P:\E137\001\GINT.GPJ



BOREHOLE	DEPTH	Classification	γ_d	MC%	c	ϕ	
B-02	**5.5**	**CLAYEY SAND(SC)**	**132**	**7**	**0.0**	**39**	Residual ●
					584.0	**45**	Peak ⊠

DIRECT SHEAR TEST (ASTM D3080)

FIGURE NO. B-6

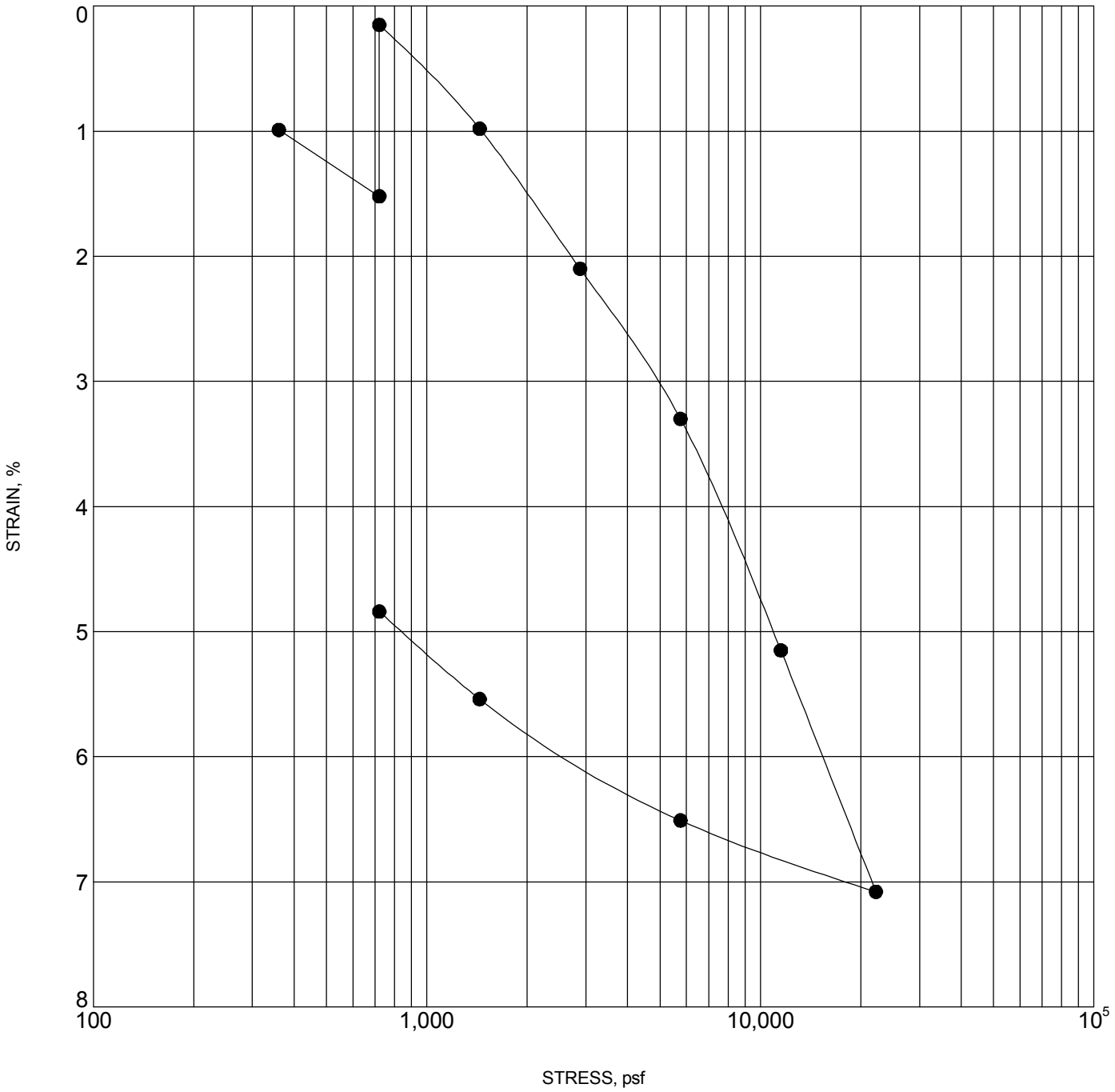
Inland Foundation Engineering, Inc.

CLIENT El Paso Oil, Inc.

PROJECT NUMBER E137-001

PROJECT NAME Geotechnical Investigation

PROJECT LOCATION Malbert Street
Perris, CA



BOREHOLE	DEPTH	Classification	γ_d	MC%
● **B-01**	**3.0**	**CLAYEY SAND(SC)**	**127**	**7**

CONSOLIDATION TEST (ASTM D2435)

Inland Foundation Engineering, Inc.

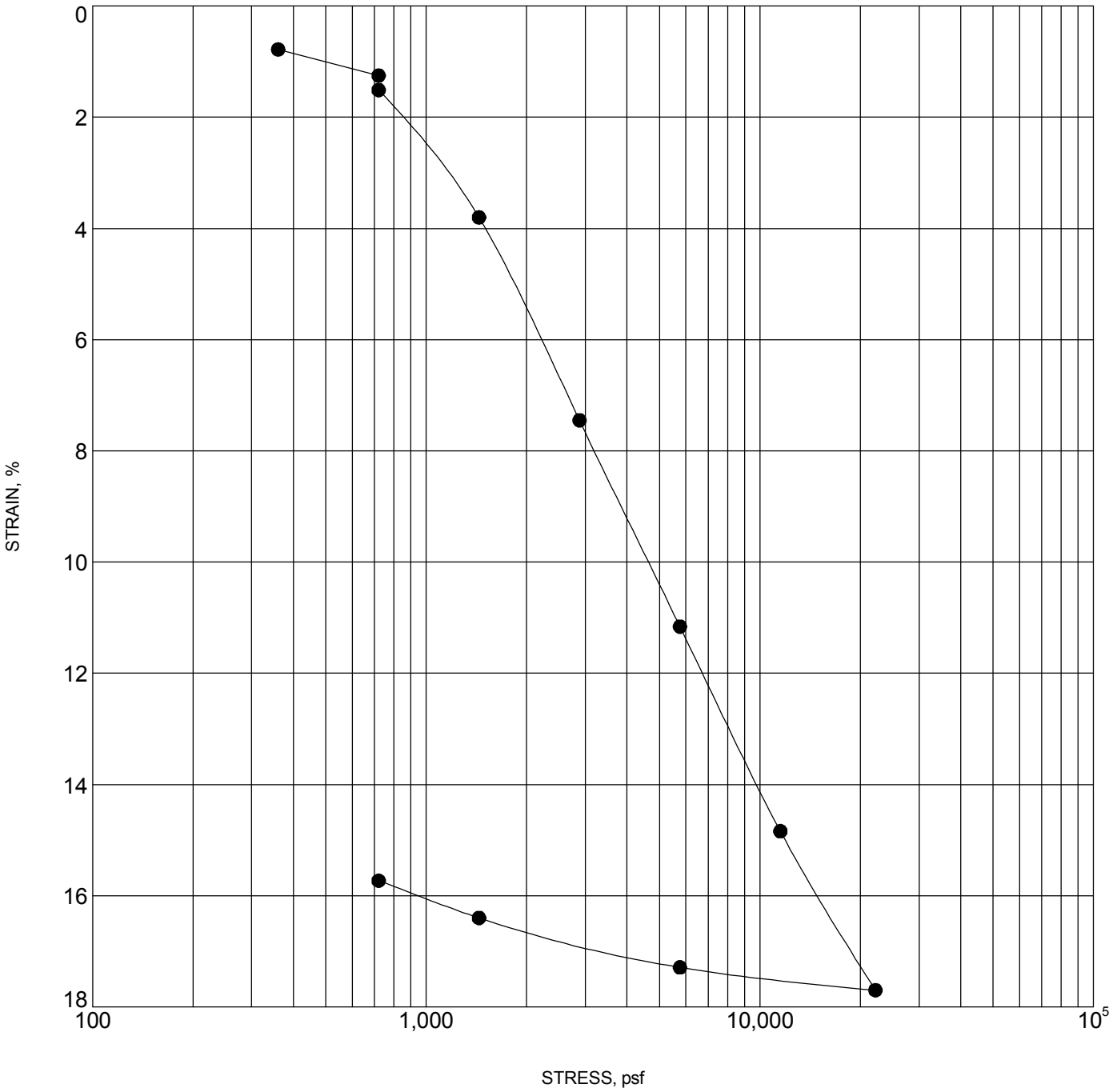
FIGURE NO. B-7

CLIENT El Paso Oil, Inc.

PROJECT NAME Geotechnical Investigation

PROJECT NUMBER E137-001

PROJECT LOCATION Malbert Street
Perris, CA



BOREHOLE		DEPTH	Classification	γ_d	MC%
●	**B-03**	**3.0**	**CLAYEY SAND(SC)**	**105**	**13**

CONSOLIDATION TEST (ASTM D2435)

Inland Foundation Engineering, Inc.

FIGURE NO. B-8

CLIENT El Paso Oil, Inc.

PROJECT NAME Geotechnical Investigation

PROJECT NUMBER E137-001

PROJECT LOCATION Malbert Street
Perris, CA

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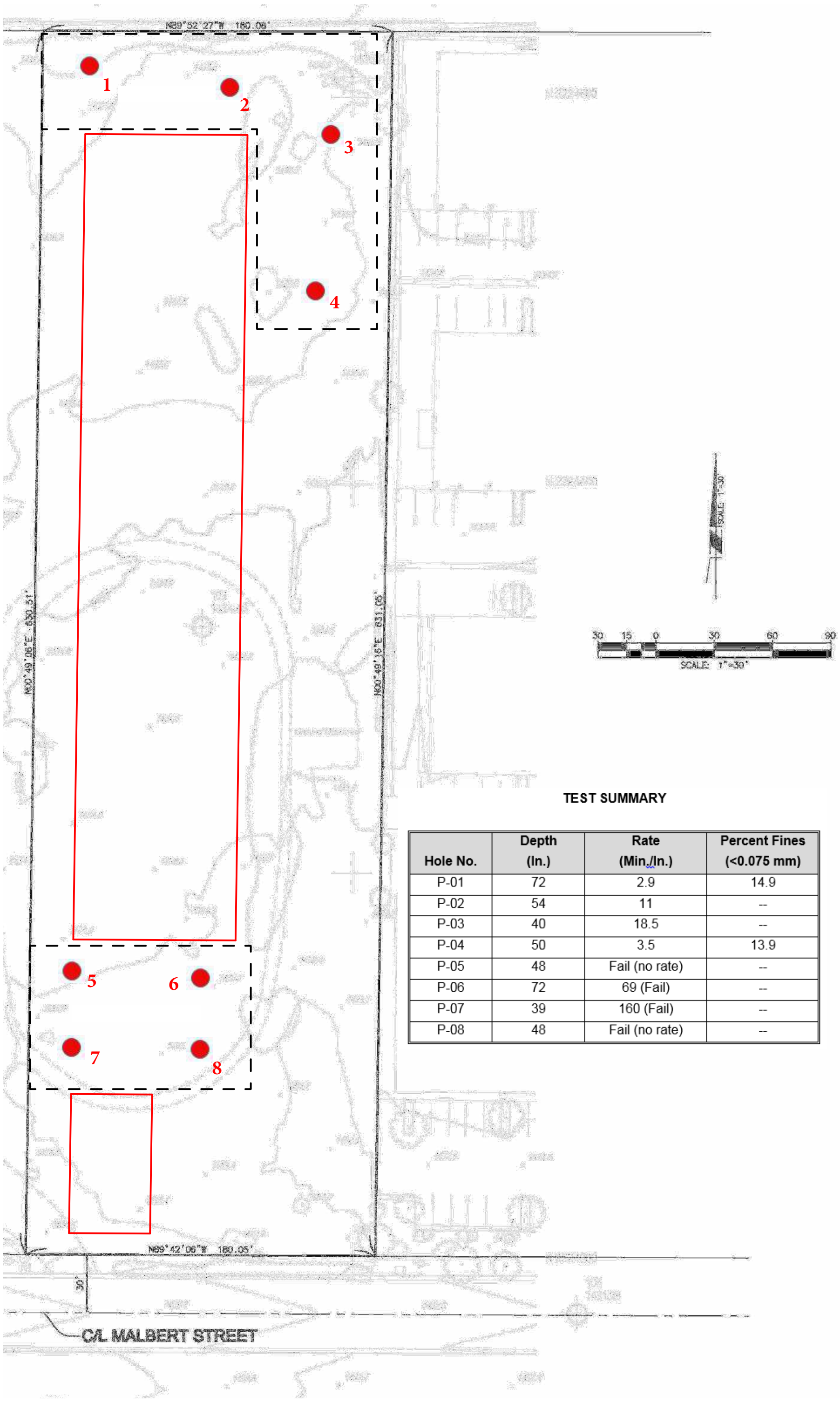


TEST SUMMARY

Hole No.	Depth (In.)	Rate (Min./In.)	Percent Fines (<0.075 mm)
P-01	72	2.9	14.9
P-02	54	11	--
P-03	40	18.5	--
P-04	50	3.5	13.9
P-05	48	Fail (no rate)	--
P-06	72	69 (Fail)	--
P-07	39	160 (Fail)	--
P-08	48	Fail (no rate)	--

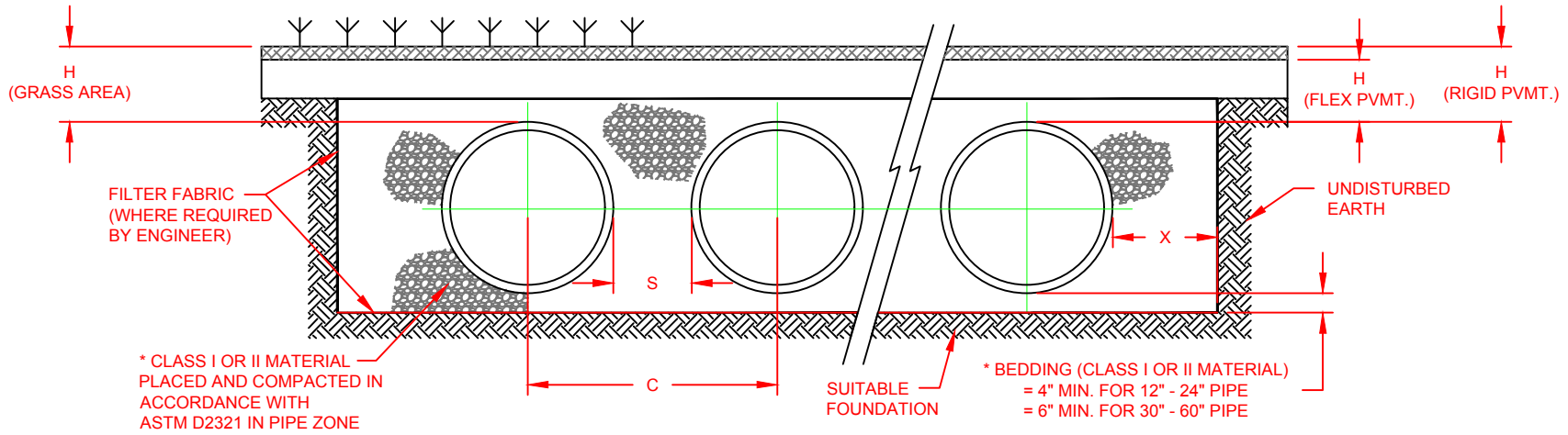
Appendix 4: Historical Site Conditions

N/A

Appendix 5: LID Infeasibility

N/A

Appendix 6: BMP Design Details



NOTES:

1. ALL REFERENCES TO CLASS I OR II MATERIAL ARE PER ASTM D2321 "STANDARD PRACTICE FOR UNDERGROUND INSTALLATION OF THERMOPLASTIC PIPE FOR SEWERS AND OTHER GRAVITY FLOW APPLICATIONS", LATEST EDITION.

2. ALL RETENTION AND DETENTION SYSTEMS SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D2321, LATEST EDITION AND THE MANUFACTURER'S PUBLISHED INSTALLATION GUIDELINES.

3. MEASURES SHOULD BE TAKEN TO PREVENT THE MIGRATION OF NATIVE FINES INTO THE BACKFILL MATERIAL, WHEN REQUIRED. SEE ASTM D2321.

4. FILTER FABRIC: A GEOTEXTILE FABRIC MAY BE USED AS SPECIFIED BY THE ENGINEER TO PREVENT THE MIGRATION OF FINES FROM THE NATIVE SOIL INTO THE SELECT BACKFILL MATERIAL.

5. FOUNDATION: WHERE THE TRENCH BOTTOM IS UNSTABLE, THE CONTRACTOR SHALL EXCAVATE TO A DEPTH REQUIRED BY THE ENGINEER AND REPLACE WITH SUITABLE MATERIAL AS SPECIFIED BY THE ENGINEER. AS AN ALTERNATIVE AND AT THE DISCRETION OF THE DESIGN ENGINEER, THE TRENCH BOTTOM MAY BE STABILIZED USING A GEOTEXTILE MATERIAL.

6. BEDDING: SUITABLE MATERIAL SHALL BE CLASS I OR II. THE CONTRACTOR SHALL PROVIDE DOCUMENTATION FOR MATERIAL SPECIFICATION TO ENGINEER. UNLESS OTHERWISE NOTED BY THE ENGINEER, MINIMUM BEDDING THICKNESS SHALL BE 4" (100mm) FOR 4"-24" (100mm-600mm); 6" (150mm) FOR 30"-60" (750mm-1500mm).

7. INITIAL BACKFILL: SUITABLE MATERIAL SHALL BE CLASS I OR II IN THE PIPE ZONE EXTENDING NOT LESS THAN 6" ABOVE CROWN OF PIPE. THE CONTRACTOR SHALL PROVIDE DOCUMENTATION FOR MATERIAL SPECIFICATION TO ENGINEER. MATERIAL SHALL BE INSTALLED AS REQUIRED IN ASTM D2321, LATEST EDITION.

8. MINIMUM COVER: MINIMUM COVER OVER ALL RETNETION/DETENTION SYSTEMS IN NON-TRAFFIC APPLICATIONS (GRASS OR LANDSCAPE AREAS) IS 12" FROM TOP OF PIPE TO GROUND SURFACE. ADDITIONAL COVER MAY BE REQUIRED TO PREVENT FLOATATION. FOR TRAFFIC APPLICATIONS, MINIMUM COVER IS 12" UP TO 36" DIAMETER PIPE AND 24" OF COVER FOR 42" - 60" DIAMETER PIPE, MEASURED FROM TOP OF PIPE TO BOTTOM OF FLEXIBLE PAVEMENT OR TO TOP OF RIGID PAVEMENT.

NOMINAL DIAMETER	NOMINAL O.D.	TYPICAL SPACING "S"	NOMINAL SPACING "C"	TYPICAL SIDE WALL "X"	H (NON-TRAFFIC)	H (TRAFFIC)
12" (300mm)	14.5" (368mm)	11" (279mm)	25.5" (648mm)	8" (203mm)	12" (305mm)	12" (305mm)
15" (375mm)	18" (457mm)	11.5" (292mm)	29.0" (737mm)	8" (203mm)	12" (305mm)	12" (305mm)
18" (450mm)	21" (533mm)	17.0" (432mm)	38.0" (965mm)	9" (229mm)	12" (305mm)	12" (305mm)
24" (600mm)	28" (711mm)	14.0" (356mm)	41.5" (1054mm)	10" (254mm)	12" (305mm)	12" (305mm)
30" (750mm)	36" (914mm)	18" (457mm)	53.0" (1346mm)	18" (457mm)	12" (305mm)	12" (305mm)
36" (900mm)	42" (1067mm)	22" (559mm)	63.0" (1600mm)	18" (457mm)	12" (305mm)	12" (305mm)
42" (1050mm)	48" (1219mm)	24" (610mm)	72.0" (1829mm)	18" (457mm)	12" (305mm)	24" (610mm)
48" (1200mm)	54" (1372mm)	25" (635mm)	78.5" (1994mm)	18" (457mm)	12" (305mm)	24" (610mm)
60" (1500mm)	67" (1702mm)	24" (610mm)	90" (2286mm)	18" (457mm)	12" (305mm)	24" (610mm)

* CLASS I BACKFILL REQUIRED AROUND 60" DIAMETER FITTINGS.

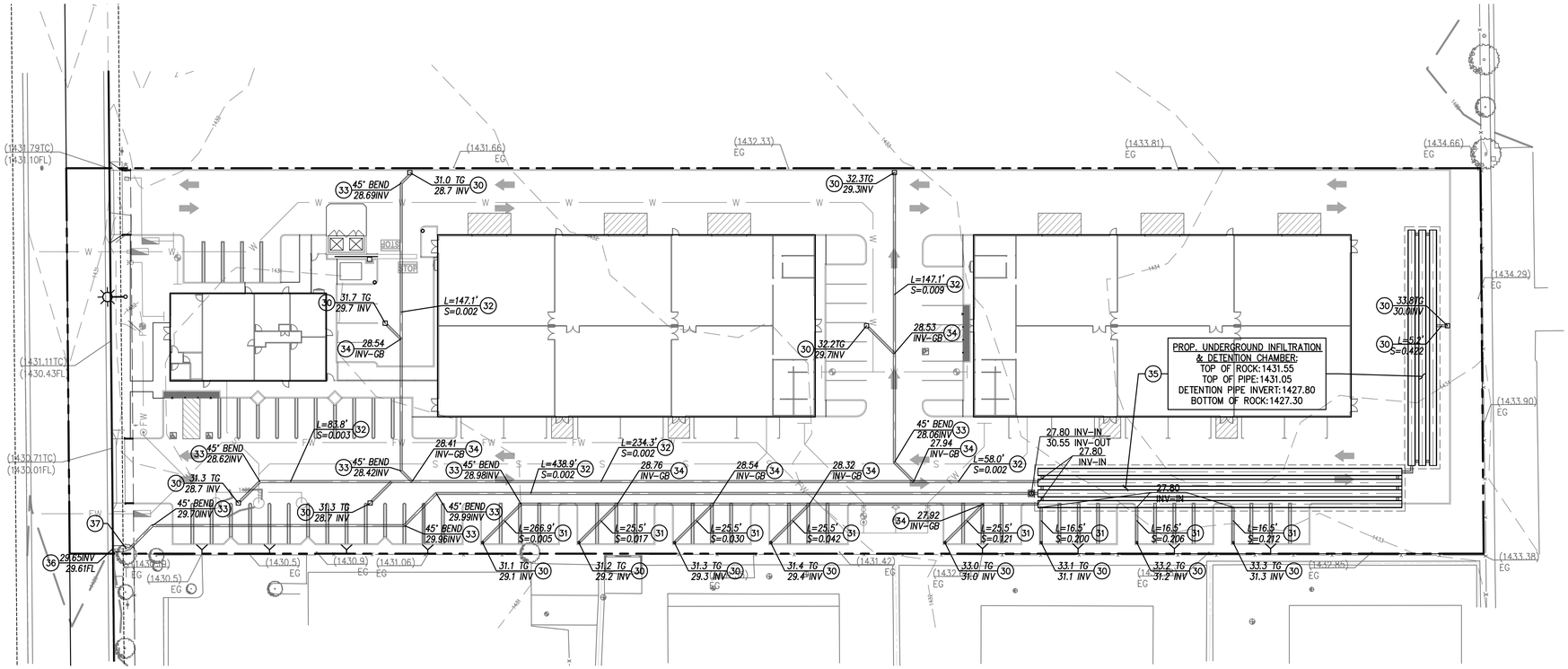
REV.	DESCRIPTION	BY	MM/DD/YY	CHK'D
4	GENERAL UPDATES AND RENAMED	TJR	02/19/16	

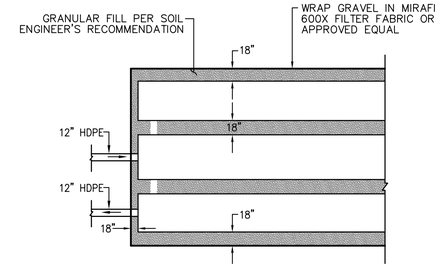
RETENTION–DETENTION SYSTEM (CROSS–SECTION)

DRAWING NUMBER: STD–702

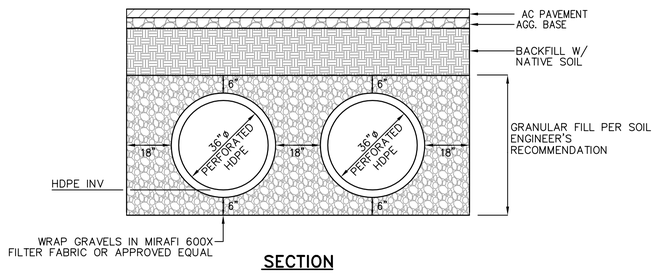
ADS
ADVANCED DRAINAGE SYSTEMS, INC.
4640 TRUEMAN BLVD
HILLIARD, OHIO 43026

DRAWN BY:	AWM
DATE:	07.25.06
CK'D BY:	
SCALE:	NTS
SHEET	OF





PLAN



SECTION

DETENTION SYSTEM			
HDPE	HDPE INV	LAYOUT	TOTAL VOLUME
36"ø	27.8'	4 ROWS OF 170 LF 3 ROWS OF 110 LF	12,400 CF

(35) COMBINED UNDERGROUND DETENTION & INFILTRATION SYSTEM
N.T.S.

STORM DRAIN CONSTRUCTION NOTES	QUANTITIES
(30) INSTALL DROP INLET WITH FILTER INSERT (KRISTAR FLOWGARD PLUS OR EQUIVALENT)	XX EA.
(31) INSTALL 8" PVC STORM DRAIN (WATERTIGHT JOINTS). TRENCH, BEDDING AND BACKFILL PER GEOTECHNICAL RECOMMENDATIONS	XX L.F.
(32) INSTALL 12" PVC STORM DRAIN (WATERTIGHT JOINTS). TRENCH, BEDDING AND BACKFILL PER GEOTECHNICAL RECOMMENDATIONS	XX L.F.
(33) INSTALL HDPE BEND, ANGLE PER PLAN	XX L.F.
(34) INSTALL HDPE WYE, SIZE PER PLAN	XX L.F.
(35) INSTALL UNDERGROUND COMBINED INFILTRATION & DETENTION SYSTEM PER DETAILS HEREON	XX L.F.
(36) INSTALL RECTANGULAR 3"X36" STEEL PIPE. OUTLET TO CURB.	XX L.F.
(37) INSTALL ADAPTER FROM 12" ROUND PIPE TO 3"X36" RECTANGULAR PIPE	XX L.F.
(38) CONSTRUCT 24"X24" CONCRETE BOX PER DETAIL HEREON OR JENSEN PRECAST DI24X24	XX L.F.

160 S. Old Springs Road
Suite 210
Anaheim Hills, CA 92808
714-685-6860
DRC Engineering, Inc.
Civil Engineering/Land Surveying/Land Planning
R.C.E. 39478
GREGORY R. COOKE
DATE

NOT FOR CONSTRUCTION

NO.:	REVISION:	DATE:

PROJECT: INDOOR NURSERY WAREHOUSE
24 MALBERT STREET
PERRIS, CALIFORNIA

DRAWING NAME: CONCEPTUAL STORM DRAIN PLAN

ISSUE:	SD101
DATE:	10/01/2019
CHECKED: CM	DRAWN: PP
DRAWNG FILE:	19228SD101
PROJECT NO.:	19-228
SHEET NUMBER:	1
OF	1 SHEETS
SCALE:	AS SHOWN

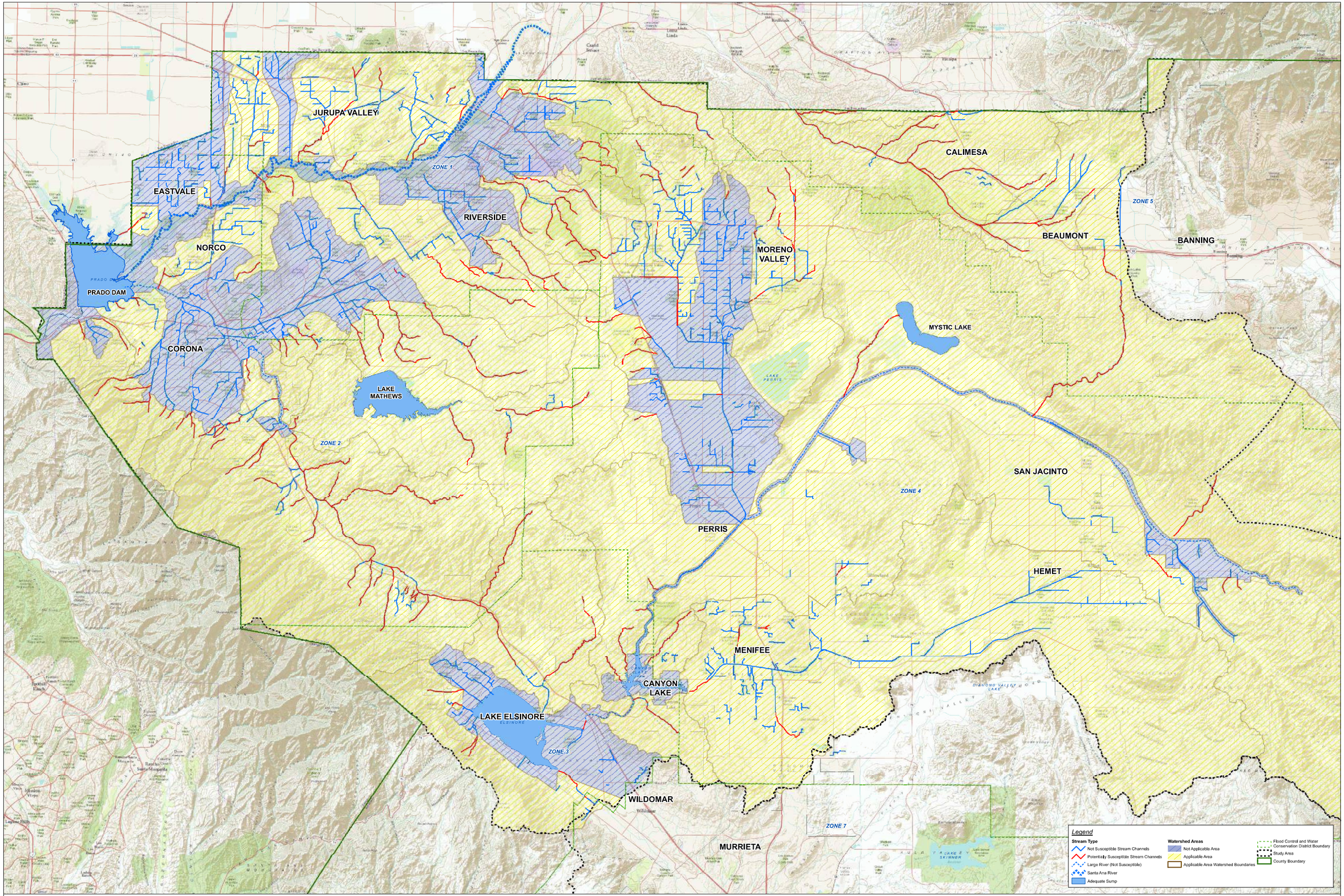
Appendix 7: Hydromodification

Map 2: HCOC Applicability Map (From Geodatabase)

Existing 2-year 24-hour Hydrology Calculation

Proposed 2-year 24-hour Hydrology Calculation

Infiltration/Detention System Hydrographs



HCOC Applicability Map

Hydromodification Susceptibility Documentation Report and Mapping
Riverside County Flood Control and Water Conservation District

Map 2

U n i t H y d r o g r a p h A n a l y s i s

Study date 09/25/19 File: 228EX2YR242.out

++

Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 6310

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

19-228 Perris
2-YR 24-HR
Existing condition

Drainage Area = 2.61(Ac.) = 0.004 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 2.61(Ac.) = 0.004 Sq. Mi.
Length along longest watercourse = 670.00(Ft.)
Length along longest watercourse measured to centroid = 316.00(Ft.)
Length along longest watercourse = 0.127 Mi.
Length along longest watercourse measured to centroid = 0.060 Mi.
Difference in elevation = 4.10(Ft.)
Slope along watercourse = 32.3104 Ft./Mi.
Average Manning's 'N' = 0.030
Lag time = 0.058 Hr.
Lag time = 3.49 Min.
25% of lag time = 0.87 Min.
40% of lag time = 1.40 Min.
Unit time = 5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
2.61	1.90	4.96

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
2.61	5.20	13.57

STORM EVENT (YEAR) = 2.00
Area Averaged 2-Year Rainfall = 1.900(In)
Area Averaged 100-Year Rainfall = 5.200(In)

Point rain (area averaged) = 1.900(In)

Areal adjustment factor = 100.00 %
Adjusted average point rain = 1.900(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
2.610	80.00	0.000

Total Area Entered = 2.61(Ac.)

RI AMC2	RI AMC-2	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
80.0	80.0	0.244	0.000	0.244	1.000	0.244
					Sum (F) =	0.244

Area averaged mean soil loss (F) (In/Hr) = 0.244
Minimum soil loss rate ((In/Hr)) = 0.122
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.900

U n i t H y d r o g r a p h
DESERT S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	143.111	29.951	0.788
2	0.167	286.222	49.305	1.297
3	0.250	429.334	12.498	0.329
4	0.333	572.445	4.996	0.131
5	0.417	715.556	2.078	0.055
6	0.500	858.667	1.172	0.031
		Sum =	100.000 Sum=	2.630

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.07	0.015	(0.433)	0.014	0.002
2	0.17	0.07	0.015	(0.431)	0.014	0.002
3	0.25	0.07	0.015	(0.429)	0.014	0.002
4	0.33	0.10	0.023	(0.428)	0.021	0.002
5	0.42	0.10	0.023	(0.426)	0.021	0.002
6	0.50	0.10	0.023	(0.424)	0.021	0.002
7	0.58	0.10	0.023	(0.423)	0.021	0.002
8	0.67	0.10	0.023	(0.421)	0.021	0.002
9	0.75	0.10	0.023	(0.419)	0.021	0.002
10	0.83	0.13	0.030	(0.418)	0.027	0.003
11	0.92	0.13	0.030	(0.416)	0.027	0.003
12	1.00	0.13	0.030	(0.414)	0.027	0.003
13	1.08	0.10	0.023	(0.413)	0.021	0.002
14	1.17	0.10	0.023	(0.411)	0.021	0.002
15	1.25	0.10	0.023	(0.409)	0.021	0.002

16	1.33	0.10	0.023	(0.408)	0.021	0.002
17	1.42	0.10	0.023	(0.406)	0.021	0.002
18	1.50	0.10	0.023	(0.405)	0.021	0.002
19	1.58	0.10	0.023	(0.403)	0.021	0.002
20	1.67	0.10	0.023	(0.401)	0.021	0.002
21	1.75	0.10	0.023	(0.400)	0.021	0.002
22	1.83	0.13	0.030	(0.398)	0.027	0.003
23	1.92	0.13	0.030	(0.396)	0.027	0.003
24	2.00	0.13	0.030	(0.395)	0.027	0.003
25	2.08	0.13	0.030	(0.393)	0.027	0.003
26	2.17	0.13	0.030	(0.392)	0.027	0.003
27	2.25	0.13	0.030	(0.390)	0.027	0.003
28	2.33	0.13	0.030	(0.389)	0.027	0.003
29	2.42	0.13	0.030	(0.387)	0.027	0.003
30	2.50	0.13	0.030	(0.385)	0.027	0.003
31	2.58	0.17	0.038	(0.384)	0.034	0.004
32	2.67	0.17	0.038	(0.382)	0.034	0.004
33	2.75	0.17	0.038	(0.381)	0.034	0.004
34	2.83	0.17	0.038	(0.379)	0.034	0.004
35	2.92	0.17	0.038	(0.378)	0.034	0.004
36	3.00	0.17	0.038	(0.376)	0.034	0.004
37	3.08	0.17	0.038	(0.374)	0.034	0.004
38	3.17	0.17	0.038	(0.373)	0.034	0.004
39	3.25	0.17	0.038	(0.371)	0.034	0.004
40	3.33	0.17	0.038	(0.370)	0.034	0.004
41	3.42	0.17	0.038	(0.368)	0.034	0.004
42	3.50	0.17	0.038	(0.367)	0.034	0.004
43	3.58	0.17	0.038	(0.365)	0.034	0.004
44	3.67	0.17	0.038	(0.364)	0.034	0.004
45	3.75	0.17	0.038	(0.362)	0.034	0.004
46	3.83	0.20	0.046	(0.361)	0.041	0.005
47	3.92	0.20	0.046	(0.359)	0.041	0.005
48	4.00	0.20	0.046	(0.357)	0.041	0.005
49	4.08	0.20	0.046	(0.356)	0.041	0.005
50	4.17	0.20	0.046	(0.354)	0.041	0.005
51	4.25	0.20	0.046	(0.353)	0.041	0.005
52	4.33	0.23	0.053	(0.351)	0.048	0.005
53	4.42	0.23	0.053	(0.350)	0.048	0.005
54	4.50	0.23	0.053	(0.348)	0.048	0.005
55	4.58	0.23	0.053	(0.347)	0.048	0.005
56	4.67	0.23	0.053	(0.345)	0.048	0.005
57	4.75	0.23	0.053	(0.344)	0.048	0.005
58	4.83	0.27	0.061	(0.342)	0.055	0.006
59	4.92	0.27	0.061	(0.341)	0.055	0.006
60	5.00	0.27	0.061	(0.340)	0.055	0.006
61	5.08	0.20	0.046	(0.338)	0.041	0.005
62	5.17	0.20	0.046	(0.337)	0.041	0.005
63	5.25	0.20	0.046	(0.335)	0.041	0.005
64	5.33	0.23	0.053	(0.334)	0.048	0.005
65	5.42	0.23	0.053	(0.332)	0.048	0.005
66	5.50	0.23	0.053	(0.331)	0.048	0.005
67	5.58	0.27	0.061	(0.329)	0.055	0.006
68	5.67	0.27	0.061	(0.328)	0.055	0.006
69	5.75	0.27	0.061	(0.326)	0.055	0.006
70	5.83	0.27	0.061	(0.325)	0.055	0.006
71	5.92	0.27	0.061	(0.324)	0.055	0.006
72	6.00	0.27	0.061	(0.322)	0.055	0.006

73	6.08	0.30	0.068	(0.321)	0.062	0.007
74	6.17	0.30	0.068	(0.319)	0.062	0.007
75	6.25	0.30	0.068	(0.318)	0.062	0.007
76	6.33	0.30	0.068	(0.316)	0.062	0.007
77	6.42	0.30	0.068	(0.315)	0.062	0.007
78	6.50	0.30	0.068	(0.314)	0.062	0.007
79	6.58	0.33	0.076	(0.312)	0.068	0.008
80	6.67	0.33	0.076	(0.311)	0.068	0.008
81	6.75	0.33	0.076	(0.309)	0.068	0.008
82	6.83	0.33	0.076	(0.308)	0.068	0.008
83	6.92	0.33	0.076	(0.307)	0.068	0.008
84	7.00	0.33	0.076	(0.305)	0.068	0.008
85	7.08	0.33	0.076	(0.304)	0.068	0.008
86	7.17	0.33	0.076	(0.302)	0.068	0.008
87	7.25	0.33	0.076	(0.301)	0.068	0.008
88	7.33	0.37	0.084	(0.300)	0.075	0.008
89	7.42	0.37	0.084	(0.298)	0.075	0.008
90	7.50	0.37	0.084	(0.297)	0.075	0.008
91	7.58	0.40	0.091	(0.296)	0.082	0.009
92	7.67	0.40	0.091	(0.294)	0.082	0.009
93	7.75	0.40	0.091	(0.293)	0.082	0.009
94	7.83	0.43	0.099	(0.291)	0.089	0.010
95	7.92	0.43	0.099	(0.290)	0.089	0.010
96	8.00	0.43	0.099	(0.289)	0.089	0.010
97	8.08	0.50	0.114	(0.287)	0.103	0.011
98	8.17	0.50	0.114	(0.286)	0.103	0.011
99	8.25	0.50	0.114	(0.285)	0.103	0.011
100	8.33	0.50	0.114	(0.283)	0.103	0.011
101	8.42	0.50	0.114	(0.282)	0.103	0.011
102	8.50	0.50	0.114	(0.281)	0.103	0.011
103	8.58	0.53	0.122	(0.279)	0.109	0.012
104	8.67	0.53	0.122	(0.278)	0.109	0.012
105	8.75	0.53	0.122	(0.277)	0.109	0.012
106	8.83	0.57	0.129	(0.276)	0.116	0.013
107	8.92	0.57	0.129	(0.274)	0.116	0.013
108	9.00	0.57	0.129	(0.273)	0.116	0.013
109	9.08	0.63	0.144	(0.272)	0.130	0.014
110	9.17	0.63	0.144	(0.270)	0.130	0.014
111	9.25	0.63	0.144	(0.269)	0.130	0.014
112	9.33	0.67	0.152	(0.268)	0.137	0.015
113	9.42	0.67	0.152	(0.266)	0.137	0.015
114	9.50	0.67	0.152	(0.265)	0.137	0.015
115	9.58	0.70	0.160	(0.264)	0.144	0.016
116	9.67	0.70	0.160	(0.263)	0.144	0.016
117	9.75	0.70	0.160	(0.261)	0.144	0.016
118	9.83	0.73	0.167	(0.260)	0.150	0.017
119	9.92	0.73	0.167	(0.259)	0.150	0.017
120	10.00	0.73	0.167	(0.258)	0.150	0.017
121	10.08	0.50	0.114	(0.256)	0.103	0.011
122	10.17	0.50	0.114	(0.255)	0.103	0.011
123	10.25	0.50	0.114	(0.254)	0.103	0.011
124	10.33	0.50	0.114	(0.253)	0.103	0.011
125	10.42	0.50	0.114	(0.251)	0.103	0.011
126	10.50	0.50	0.114	(0.250)	0.103	0.011
127	10.58	0.67	0.152	(0.249)	0.137	0.015
128	10.67	0.67	0.152	(0.248)	0.137	0.015
129	10.75	0.67	0.152	(0.247)	0.137	0.015

130	10.83	0.67	0.152	(0.245)	0.137	0.015
131	10.92	0.67	0.152	(0.244)	0.137	0.015
132	11.00	0.67	0.152	(0.243)	0.137	0.015
133	11.08	0.63	0.144	(0.242)	0.130	0.014
134	11.17	0.63	0.144	(0.241)	0.130	0.014
135	11.25	0.63	0.144	(0.239)	0.130	0.014
136	11.33	0.63	0.144	(0.238)	0.130	0.014
137	11.42	0.63	0.144	(0.237)	0.130	0.014
138	11.50	0.63	0.144	(0.236)	0.130	0.014
139	11.58	0.57	0.129	(0.235)	0.116	0.013
140	11.67	0.57	0.129	(0.234)	0.116	0.013
141	11.75	0.57	0.129	(0.232)	0.116	0.013
142	11.83	0.60	0.137	(0.231)	0.123	0.014
143	11.92	0.60	0.137	(0.230)	0.123	0.014
144	12.00	0.60	0.137	(0.229)	0.123	0.014
145	12.08	0.83	0.190	(0.228)	0.171	0.019
146	12.17	0.83	0.190	(0.227)	0.171	0.019
147	12.25	0.83	0.190	(0.225)	0.171	0.019
148	12.33	0.87	0.198	(0.224)	0.178	0.020
149	12.42	0.87	0.198	(0.223)	0.178	0.020
150	12.50	0.87	0.198	(0.222)	0.178	0.020
151	12.58	0.93	0.213	(0.221)	0.192	0.021
152	12.67	0.93	0.213	(0.220)	0.192	0.021
153	12.75	0.93	0.213	(0.219)	0.192	0.021
154	12.83	0.97	0.220	(0.218)	0.198	0.022
155	12.92	0.97	0.220	(0.217)	0.198	0.022
156	13.00	0.97	0.220	(0.215)	0.198	0.022
157	13.08	1.13	0.258	0.214	(0.233)	0.044
158	13.17	1.13	0.258	0.213	(0.233)	0.045
159	13.25	1.13	0.258	0.212	(0.233)	0.046
160	13.33	1.13	0.258	0.211	(0.233)	0.047
161	13.42	1.13	0.258	0.210	(0.233)	0.048
162	13.50	1.13	0.258	0.209	(0.233)	0.049
163	13.58	0.77	0.175	(0.208)	0.157	0.017
164	13.67	0.77	0.175	(0.207)	0.157	0.017
165	13.75	0.77	0.175	(0.206)	0.157	0.017
166	13.83	0.77	0.175	(0.205)	0.157	0.017
167	13.92	0.77	0.175	(0.204)	0.157	0.017
168	14.00	0.77	0.175	(0.203)	0.157	0.017
169	14.08	0.90	0.205	(0.202)	0.185	0.021
170	14.17	0.90	0.205	(0.201)	0.185	0.021
171	14.25	0.90	0.205	(0.200)	0.185	0.021
172	14.33	0.87	0.198	(0.199)	0.178	0.020
173	14.42	0.87	0.198	(0.198)	0.178	0.020
174	14.50	0.87	0.198	(0.197)	0.178	0.020
175	14.58	0.87	0.198	(0.196)	0.178	0.020
176	14.67	0.87	0.198	(0.195)	0.178	0.020
177	14.75	0.87	0.198	(0.194)	0.178	0.020
178	14.83	0.83	0.190	(0.193)	0.171	0.019
179	14.92	0.83	0.190	(0.192)	0.171	0.019
180	15.00	0.83	0.190	(0.191)	0.171	0.019
181	15.08	0.80	0.182	(0.190)	0.164	0.018
182	15.17	0.80	0.182	(0.189)	0.164	0.018
183	15.25	0.80	0.182	(0.188)	0.164	0.018
184	15.33	0.77	0.175	(0.187)	0.157	0.017
185	15.42	0.77	0.175	(0.186)	0.157	0.017
186	15.50	0.77	0.175	(0.185)	0.157	0.017

187	15.58	0.63	0.144	(0.184)	0.130	0.014
188	15.67	0.63	0.144	(0.183)	0.130	0.014
189	15.75	0.63	0.144	(0.182)	0.130	0.014
190	15.83	0.63	0.144	(0.181)	0.130	0.014
191	15.92	0.63	0.144	(0.180)	0.130	0.014
192	16.00	0.63	0.144	(0.179)	0.130	0.014
193	16.08	0.13	0.030	(0.178)	0.027	0.003
194	16.17	0.13	0.030	(0.177)	0.027	0.003
195	16.25	0.13	0.030	(0.176)	0.027	0.003
196	16.33	0.13	0.030	(0.176)	0.027	0.003
197	16.42	0.13	0.030	(0.175)	0.027	0.003
198	16.50	0.13	0.030	(0.174)	0.027	0.003
199	16.58	0.10	0.023	(0.173)	0.021	0.002
200	16.67	0.10	0.023	(0.172)	0.021	0.002
201	16.75	0.10	0.023	(0.171)	0.021	0.002
202	16.83	0.10	0.023	(0.170)	0.021	0.002
203	16.92	0.10	0.023	(0.169)	0.021	0.002
204	17.00	0.10	0.023	(0.169)	0.021	0.002
205	17.08	0.17	0.038	(0.168)	0.034	0.004
206	17.17	0.17	0.038	(0.167)	0.034	0.004
207	17.25	0.17	0.038	(0.166)	0.034	0.004
208	17.33	0.17	0.038	(0.165)	0.034	0.004
209	17.42	0.17	0.038	(0.164)	0.034	0.004
210	17.50	0.17	0.038	(0.164)	0.034	0.004
211	17.58	0.17	0.038	(0.163)	0.034	0.004
212	17.67	0.17	0.038	(0.162)	0.034	0.004
213	17.75	0.17	0.038	(0.161)	0.034	0.004
214	17.83	0.13	0.030	(0.160)	0.027	0.003
215	17.92	0.13	0.030	(0.159)	0.027	0.003
216	18.00	0.13	0.030	(0.159)	0.027	0.003
217	18.08	0.13	0.030	(0.158)	0.027	0.003
218	18.17	0.13	0.030	(0.157)	0.027	0.003
219	18.25	0.13	0.030	(0.156)	0.027	0.003
220	18.33	0.13	0.030	(0.156)	0.027	0.003
221	18.42	0.13	0.030	(0.155)	0.027	0.003
222	18.50	0.13	0.030	(0.154)	0.027	0.003
223	18.58	0.10	0.023	(0.153)	0.021	0.002
224	18.67	0.10	0.023	(0.153)	0.021	0.002
225	18.75	0.10	0.023	(0.152)	0.021	0.002
226	18.83	0.07	0.015	(0.151)	0.014	0.002
227	18.92	0.07	0.015	(0.150)	0.014	0.002
228	19.00	0.07	0.015	(0.150)	0.014	0.002
229	19.08	0.10	0.023	(0.149)	0.021	0.002
230	19.17	0.10	0.023	(0.148)	0.021	0.002
231	19.25	0.10	0.023	(0.148)	0.021	0.002
232	19.33	0.13	0.030	(0.147)	0.027	0.003
233	19.42	0.13	0.030	(0.146)	0.027	0.003
234	19.50	0.13	0.030	(0.146)	0.027	0.003
235	19.58	0.10	0.023	(0.145)	0.021	0.002
236	19.67	0.10	0.023	(0.144)	0.021	0.002
237	19.75	0.10	0.023	(0.144)	0.021	0.002
238	19.83	0.07	0.015	(0.143)	0.014	0.002
239	19.92	0.07	0.015	(0.142)	0.014	0.002
240	20.00	0.07	0.015	(0.142)	0.014	0.002
241	20.08	0.10	0.023	(0.141)	0.021	0.002
242	20.17	0.10	0.023	(0.140)	0.021	0.002
243	20.25	0.10	0.023	(0.140)	0.021	0.002

244	20.33	0.10	0.023	(0.139)	0.021	0.002
245	20.42	0.10	0.023	(0.139)	0.021	0.002
246	20.50	0.10	0.023	(0.138)	0.021	0.002
247	20.58	0.10	0.023	(0.137)	0.021	0.002
248	20.67	0.10	0.023	(0.137)	0.021	0.002
249	20.75	0.10	0.023	(0.136)	0.021	0.002
250	20.83	0.07	0.015	(0.136)	0.014	0.002
251	20.92	0.07	0.015	(0.135)	0.014	0.002
252	21.00	0.07	0.015	(0.135)	0.014	0.002
253	21.08	0.10	0.023	(0.134)	0.021	0.002
254	21.17	0.10	0.023	(0.134)	0.021	0.002
255	21.25	0.10	0.023	(0.133)	0.021	0.002
256	21.33	0.07	0.015	(0.133)	0.014	0.002
257	21.42	0.07	0.015	(0.132)	0.014	0.002
258	21.50	0.07	0.015	(0.132)	0.014	0.002
259	21.58	0.10	0.023	(0.131)	0.021	0.002
260	21.67	0.10	0.023	(0.131)	0.021	0.002
261	21.75	0.10	0.023	(0.130)	0.021	0.002
262	21.83	0.07	0.015	(0.130)	0.014	0.002
263	21.92	0.07	0.015	(0.129)	0.014	0.002
264	22.00	0.07	0.015	(0.129)	0.014	0.002
265	22.08	0.10	0.023	(0.128)	0.021	0.002
266	22.17	0.10	0.023	(0.128)	0.021	0.002
267	22.25	0.10	0.023	(0.128)	0.021	0.002
268	22.33	0.07	0.015	(0.127)	0.014	0.002
269	22.42	0.07	0.015	(0.127)	0.014	0.002
270	22.50	0.07	0.015	(0.126)	0.014	0.002
271	22.58	0.07	0.015	(0.126)	0.014	0.002
272	22.67	0.07	0.015	(0.126)	0.014	0.002
273	22.75	0.07	0.015	(0.125)	0.014	0.002
274	22.83	0.07	0.015	(0.125)	0.014	0.002
275	22.92	0.07	0.015	(0.125)	0.014	0.002
276	23.00	0.07	0.015	(0.124)	0.014	0.002
277	23.08	0.07	0.015	(0.124)	0.014	0.002
278	23.17	0.07	0.015	(0.124)	0.014	0.002
279	23.25	0.07	0.015	(0.124)	0.014	0.002
280	23.33	0.07	0.015	(0.123)	0.014	0.002
281	23.42	0.07	0.015	(0.123)	0.014	0.002
282	23.50	0.07	0.015	(0.123)	0.014	0.002
283	23.58	0.07	0.015	(0.123)	0.014	0.002
284	23.67	0.07	0.015	(0.122)	0.014	0.002
285	23.75	0.07	0.015	(0.122)	0.014	0.002
286	23.83	0.07	0.015	(0.122)	0.014	0.002
287	23.92	0.07	0.015	(0.122)	0.014	0.002
288	24.00	0.07	0.015	(0.122)	0.014	0.002

(Loss Rate Not Used)

Sum = 100.0 Sum = 2.4

Flood volume = Effective rainfall 0.20(In)
times area 2.6(Ac.)/[(In)/(Ft.)] = 0.0(Ac.Ft)
Total soil loss = 1.70(In)
Total soil loss = 0.370(Ac.Ft)
Total rainfall = 1.90(In)
Flood volume = 1899.0 Cubic Feet
Total soil loss = 16102.1 Cubic Feet

Peak flow rate of this hydrograph = 0.127(CFS)

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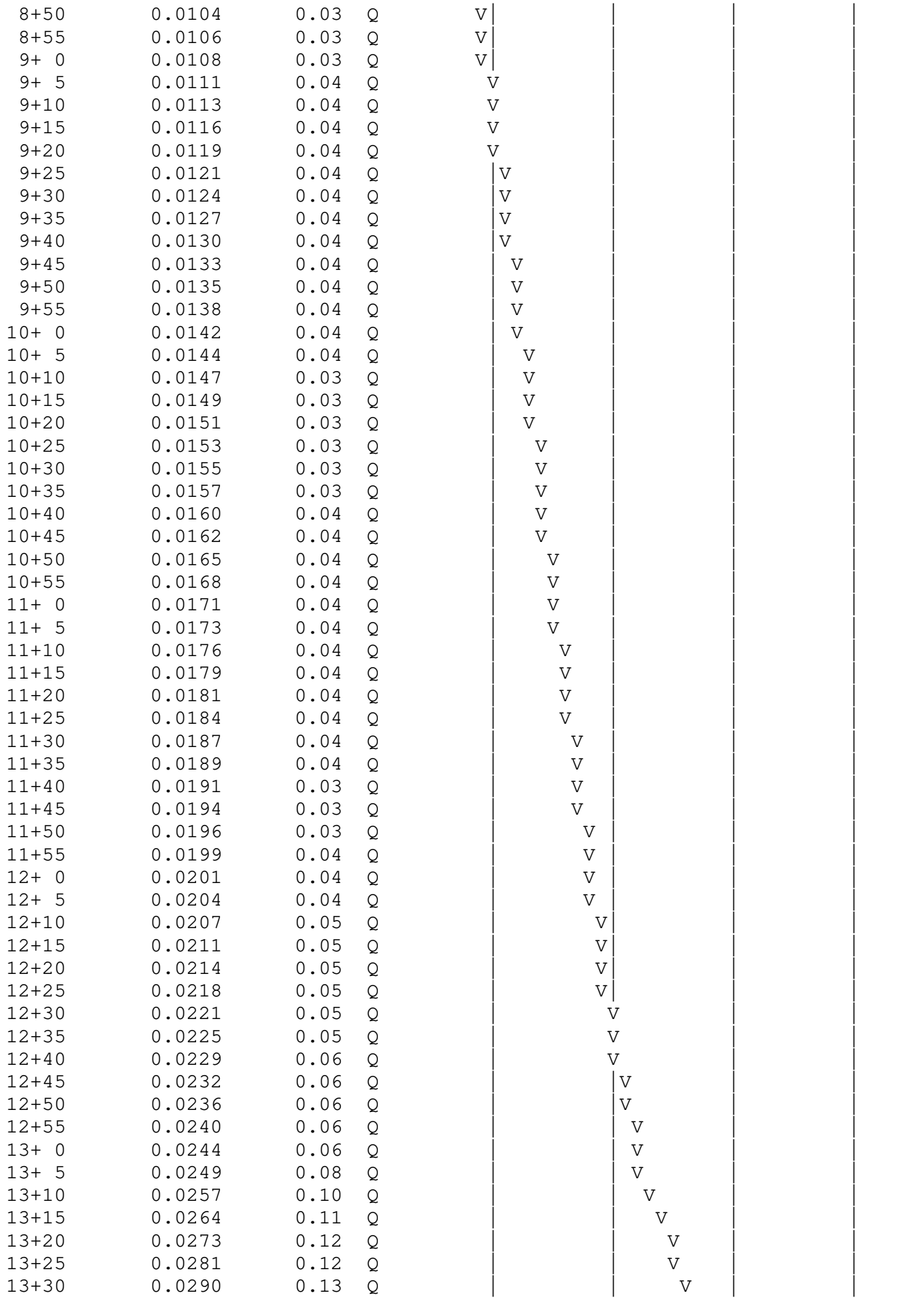
24 - H O U R S T O R M

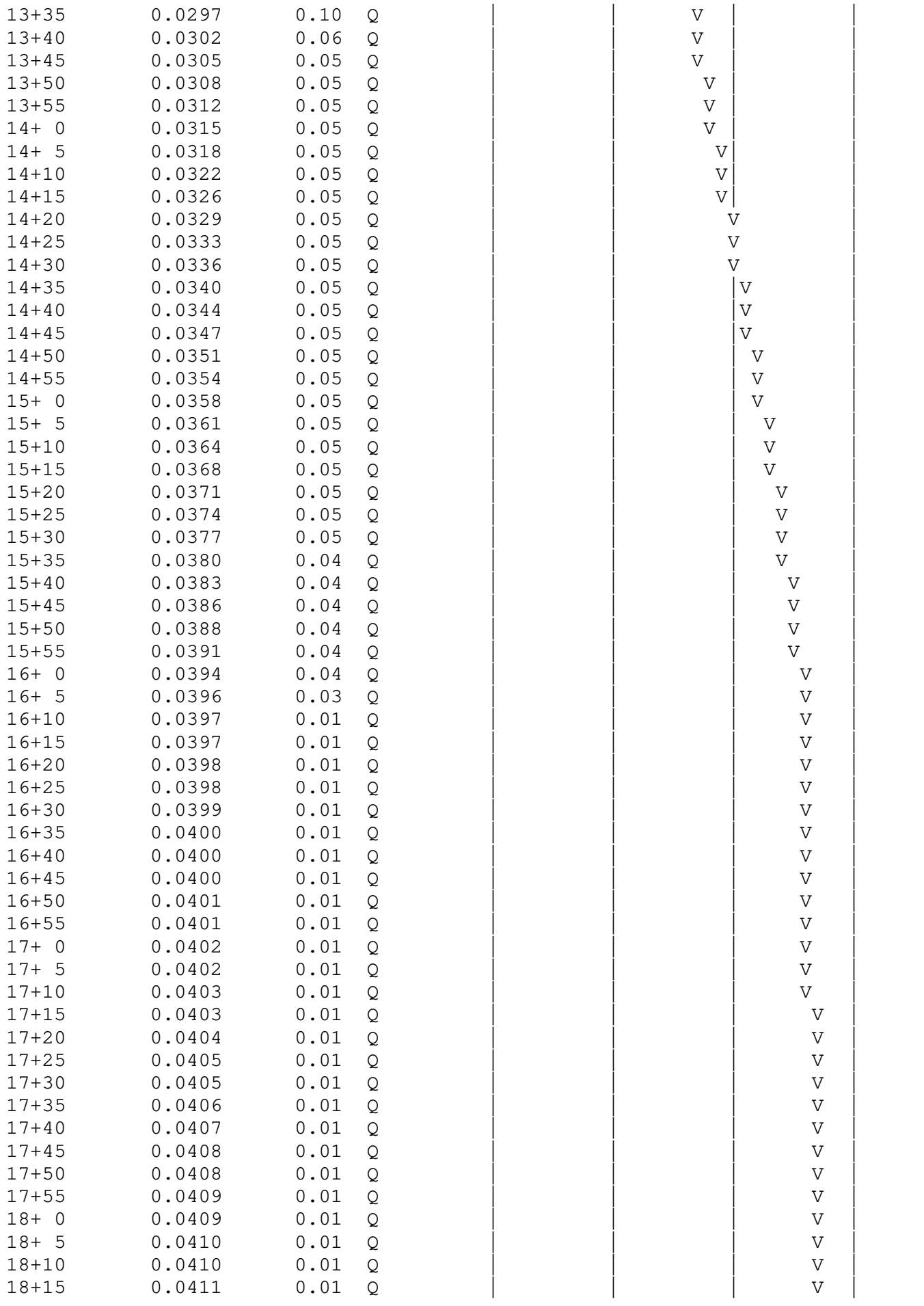
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0000	0.00	Q				
0+10	0.0000	0.00	Q				
0+15	0.0001	0.00	Q				
0+20	0.0001	0.00	Q				
0+25	0.0001	0.01	Q				
0+30	0.0002	0.01	Q				
0+35	0.0002	0.01	Q				
0+40	0.0002	0.01	Q				
0+45	0.0003	0.01	Q				
0+50	0.0003	0.01	Q				
0+55	0.0004	0.01	Q				
1+ 0	0.0004	0.01	Q				
1+ 5	0.0005	0.01	Q				
1+10	0.0005	0.01	Q				
1+15	0.0006	0.01	Q				
1+20	0.0006	0.01	Q				
1+25	0.0007	0.01	Q				
1+30	0.0007	0.01	Q				
1+35	0.0007	0.01	Q				
1+40	0.0008	0.01	Q				
1+45	0.0008	0.01	Q				
1+50	0.0009	0.01	Q				
1+55	0.0009	0.01	Q				
2+ 0	0.0010	0.01	Q				
2+ 5	0.0010	0.01	Q				
2+10	0.0011	0.01	Q				
2+15	0.0011	0.01	QV				
2+20	0.0012	0.01	QV				
2+25	0.0013	0.01	QV				
2+30	0.0013	0.01	QV				
2+35	0.0014	0.01	QV				
2+40	0.0014	0.01	QV				
2+45	0.0015	0.01	QV				
2+50	0.0016	0.01	QV				
2+55	0.0016	0.01	QV				
3+ 0	0.0017	0.01	QV				
3+ 5	0.0018	0.01	QV				
3+10	0.0018	0.01	QV				
3+15	0.0019	0.01	QV				
3+20	0.0020	0.01	QV				
3+25	0.0021	0.01	QV				
3+30	0.0021	0.01	QV				
3+35	0.0022	0.01	Q V				
3+40	0.0023	0.01	Q V				
3+45	0.0023	0.01	Q V				
3+50	0.0024	0.01	Q V				
3+55	0.0025	0.01	Q V				
4+ 0	0.0026	0.01	Q V				

4+ 5	0.0026	0.01	Q V	|	|	|	|
4+10	0.0027	0.01	Q V	|	|	|	|
4+15	0.0028	0.01	Q V	|	|	|	|
4+20	0.0029	0.01	Q V	|	|	|	|
4+25	0.0030	0.01	Q V	|	|	|	|
4+30	0.0031	0.01	Q V	|	|	|	|
4+35	0.0032	0.01	Q V	|	|	|	|
4+40	0.0033	0.01	Q V	|	|	|	|
4+45	0.0034	0.01	Q V	|	|	|	|
4+50	0.0035	0.01	Q V	|	|	|	|
4+55	0.0036	0.02	Q V	|	|	|	|
5+ 0	0.0037	0.02	Q V	|	|	|	|
5+ 5	0.0038	0.01	Q V	|	|	|	|
5+10	0.0039	0.01	Q V	|	|	|	|
5+15	0.0040	0.01	Q V	|	|	|	|
5+20	0.0041	0.01	Q V	|	|	|	|
5+25	0.0041	0.01	Q V	|	|	|	|
5+30	0.0042	0.01	Q V	|	|	|	|
5+35	0.0043	0.01	Q V	|	|	|	|
5+40	0.0044	0.02	Q V	|	|	|	|
5+45	0.0046	0.02	Q V	|	|	|	|
5+50	0.0047	0.02	Q V	|	|	|	|
5+55	0.0048	0.02	Q V	|	|	|	|
6+ 0	0.0049	0.02	Q V	|	|	|	|
6+ 5	0.0050	0.02	Q V	|	|	|	|
6+10	0.0051	0.02	Q V	|	|	|	|
6+15	0.0052	0.02	Q V	|	|	|	|
6+20	0.0054	0.02	Q V	|	|	|	|
6+25	0.0055	0.02	Q V	|	|	|	|
6+30	0.0056	0.02	Q V	|	|	|	|
6+35	0.0057	0.02	Q V	|	|	|	|
6+40	0.0059	0.02	Q V	|	|	|	|
6+45	0.0060	0.02	Q V	|	|	|	|
6+50	0.0062	0.02	Q V	|	|	|	|
6+55	0.0063	0.02	Q V	|	|	|	|
7+ 0	0.0064	0.02	Q V	|	|	|	|
7+ 5	0.0066	0.02	Q V	|	|	|	|
7+10	0.0067	0.02	Q V	|	|	|	|
7+15	0.0068	0.02	Q V	|	|	|	|
7+20	0.0070	0.02	Q V	|	|	|	|
7+25	0.0071	0.02	Q V	|	|	|	|
7+30	0.0073	0.02	Q V	|	|	|	|
7+35	0.0074	0.02	Q V	|	|	|	|
7+40	0.0076	0.02	Q V	|	|	|	|
7+45	0.0078	0.02	Q V	|	|	|	|
7+50	0.0079	0.02	Q V	|	|	|	|
7+55	0.0081	0.03	Q V	|	|	|	|
8+ 0	0.0083	0.03	Q V	|	|	|	|
8+ 5	0.0085	0.03	Q V	|	|	|	|
8+10	0.0087	0.03	Q V	|	|	|	|
8+15	0.0089	0.03	Q V	|	|	|	|
8+20	0.0091	0.03	Q V	|	|	|	|
8+25	0.0093	0.03	Q V	|	|	|	|
8+30	0.0095	0.03	Q V	|	|	|	|
8+35	0.0097	0.03	Q V	|	|	|	|
8+40	0.0099	0.03	Q V	|	|	|	|
8+45	0.0101	0.03	Q V	|	|	|	|





18+20	0.0412	0.01	Q				V
18+25	0.0412	0.01	Q				V
18+30	0.0413	0.01	Q				V
18+35	0.0413	0.01	Q				V
18+40	0.0414	0.01	Q				V
18+45	0.0414	0.01	Q				V
18+50	0.0414	0.01	Q				V
18+55	0.0415	0.00	Q				V
19+ 0	0.0415	0.00	Q				V
19+ 5	0.0415	0.00	Q				V
19+10	0.0416	0.01	Q				V
19+15	0.0416	0.01	Q				V
19+20	0.0417	0.01	Q				V
19+25	0.0417	0.01	Q				V
19+30	0.0418	0.01	Q				V
19+35	0.0418	0.01	Q				V
19+40	0.0419	0.01	Q				V
19+45	0.0419	0.01	Q				V
19+50	0.0419	0.01	Q				V
19+55	0.0420	0.00	Q				V
20+ 0	0.0420	0.00	Q				V
20+ 5	0.0420	0.00	Q				V
20+10	0.0421	0.01	Q				V
20+15	0.0421	0.01	Q				V
20+20	0.0421	0.01	Q				V
20+25	0.0422	0.01	Q				V
20+30	0.0422	0.01	Q				V
20+35	0.0423	0.01	Q				V
20+40	0.0423	0.01	Q				V
20+45	0.0424	0.01	Q				V
20+50	0.0424	0.01	Q				V
20+55	0.0424	0.00	Q				V
21+ 0	0.0425	0.00	Q				V
21+ 5	0.0425	0.00	Q				V
21+10	0.0425	0.01	Q				V
21+15	0.0426	0.01	Q				V
21+20	0.0426	0.01	Q				V
21+25	0.0426	0.00	Q				V
21+30	0.0427	0.00	Q				V
21+35	0.0427	0.00	Q				V
21+40	0.0427	0.01	Q				V
21+45	0.0428	0.01	Q				V
21+50	0.0428	0.01	Q				V
21+55	0.0428	0.00	Q				V
22+ 0	0.0429	0.00	Q				V
22+ 5	0.0429	0.00	Q				V
22+10	0.0429	0.01	Q				V
22+15	0.0430	0.01	Q				V
22+20	0.0430	0.01	Q				V
22+25	0.0430	0.00	Q				V
22+30	0.0431	0.00	Q				V
22+35	0.0431	0.00	Q				V
22+40	0.0431	0.00	Q				V
22+45	0.0432	0.00	Q				V
22+50	0.0432	0.00	Q				V
22+55	0.0432	0.00	Q				V
23+ 0	0.0432	0.00	Q				V

23+ 5	0.0433	0.00	Q	|	|	|	V|
23+10	0.0433	0.00	Q	|	|	|	V|
23+15	0.0433	0.00	Q	|	|	|	V|
23+20	0.0433	0.00	Q	|	|	|	V|
23+25	0.0434	0.00	Q	|	|	|	V|
23+30	0.0434	0.00	Q	|	|	|	V|
23+35	0.0434	0.00	Q	|	|	|	V|
23+40	0.0435	0.00	Q	|	|	|	V|
23+45	0.0435	0.00	Q	|	|	|	V|
23+50	0.0435	0.00	Q	|	|	|	V|
23+55	0.0435	0.00	Q	|	|	|	V|
24+ 0	0.0436	0.00	Q	|	|	|	V|
24+ 5	0.0436	0.00	Q	|	|	|	V|
24+10	0.0436	0.00	Q	|	|	|	V|
24+15	0.0436	0.00	Q	|	|	|	V|
24+20	0.0436	0.00	Q	|	|	|	V|
24+25	0.0436	0.00	Q	|	|	|	V

U n i t H y d r o g r a p h A n a l y s i s

Study date 09/25/19 File: 228PR2YR242.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 6310

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

19-228 Perris
2-YR 24-HR
Proposed Condition

Drainage Area = 2.61(Ac.) = 0.004 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 2.61(Ac.) = 0.004 Sq. Mi.
Length along longest watercourse = 802.00(Ft.)
Length along longest watercourse measured to centroid = 113.00(Ft.)
Length along longest watercourse = 0.152 Mi.
Length along longest watercourse measured to centroid = 0.021 Mi.
Difference in elevation = 5.30(Ft.)
Slope along watercourse = 34.8928 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time = 0.021 Hr.
Lag time = 1.25 Min.
25% of lag time = 0.31 Min.
40% of lag time = 0.50 Min.
Unit time = 5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
2.61	1.90	4.96

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
2.61	5.20	13.57

STORM EVENT (YEAR) = 2.00
Area Averaged 2-Year Rainfall = 1.900(In)
Area Averaged 100-Year Rainfall = 5.200(In)

Point rain (area averaged) = 1.900(In)

Areal adjustment factor = 100.00 %
Adjusted average point rain = 1.900(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
2.610	69.00	0.826

Total Area Entered = 2.61(Ac.)

RI AMC2	RI AMC-2	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
69.0	69.0	0.373	0.826	0.096	1.000	0.096
					Sum (F) =	0.096

Area averaged mean soil loss (F) (In/Hr) = 0.096
Minimum soil loss rate ((In/Hr)) = 0.048
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.239

U n i t H y d r o g r a p h
DESERT S-Curve

Unit Hydrograph Data

Unit time period (hrs)	Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	400.942	65.045	1.711
2	0.167	801.884	34.955	0.919
		Sum = 100.000	Sum=	2.630

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.07	0.015	(0.170)	0.004	0.012
2	0.17	0.07	0.015	(0.169)	0.004	0.012
3	0.25	0.07	0.015	(0.168)	0.004	0.012
4	0.33	0.10	0.023	(0.168)	0.005	0.017
5	0.42	0.10	0.023	(0.167)	0.005	0.017
6	0.50	0.10	0.023	(0.166)	0.005	0.017
7	0.58	0.10	0.023	(0.166)	0.005	0.017
8	0.67	0.10	0.023	(0.165)	0.005	0.017
9	0.75	0.10	0.023	(0.164)	0.005	0.017
10	0.83	0.13	0.030	(0.164)	0.007	0.023
11	0.92	0.13	0.030	(0.163)	0.007	0.023
12	1.00	0.13	0.030	(0.162)	0.007	0.023
13	1.08	0.10	0.023	(0.162)	0.005	0.017
14	1.17	0.10	0.023	(0.161)	0.005	0.017
15	1.25	0.10	0.023	(0.161)	0.005	0.017
16	1.33	0.10	0.023	(0.160)	0.005	0.017
17	1.42	0.10	0.023	(0.159)	0.005	0.017
18	1.50	0.10	0.023	(0.159)	0.005	0.017
19	1.58	0.10	0.023	(0.158)	0.005	0.017

20	1.67	0.10	0.023	(0.157)	0.005	0.017
21	1.75	0.10	0.023	(0.157)	0.005	0.017
22	1.83	0.13	0.030	(0.156)	0.007	0.023
23	1.92	0.13	0.030	(0.155)	0.007	0.023
24	2.00	0.13	0.030	(0.155)	0.007	0.023
25	2.08	0.13	0.030	(0.154)	0.007	0.023
26	2.17	0.13	0.030	(0.154)	0.007	0.023
27	2.25	0.13	0.030	(0.153)	0.007	0.023
28	2.33	0.13	0.030	(0.152)	0.007	0.023
29	2.42	0.13	0.030	(0.152)	0.007	0.023
30	2.50	0.13	0.030	(0.151)	0.007	0.023
31	2.58	0.17	0.038	(0.150)	0.009	0.029
32	2.67	0.17	0.038	(0.150)	0.009	0.029
33	2.75	0.17	0.038	(0.149)	0.009	0.029
34	2.83	0.17	0.038	(0.149)	0.009	0.029
35	2.92	0.17	0.038	(0.148)	0.009	0.029
36	3.00	0.17	0.038	(0.147)	0.009	0.029
37	3.08	0.17	0.038	(0.147)	0.009	0.029
38	3.17	0.17	0.038	(0.146)	0.009	0.029
39	3.25	0.17	0.038	(0.146)	0.009	0.029
40	3.33	0.17	0.038	(0.145)	0.009	0.029
41	3.42	0.17	0.038	(0.144)	0.009	0.029
42	3.50	0.17	0.038	(0.144)	0.009	0.029
43	3.58	0.17	0.038	(0.143)	0.009	0.029
44	3.67	0.17	0.038	(0.143)	0.009	0.029
45	3.75	0.17	0.038	(0.142)	0.009	0.029
46	3.83	0.20	0.046	(0.141)	0.011	0.035
47	3.92	0.20	0.046	(0.141)	0.011	0.035
48	4.00	0.20	0.046	(0.140)	0.011	0.035
49	4.08	0.20	0.046	(0.140)	0.011	0.035
50	4.17	0.20	0.046	(0.139)	0.011	0.035
51	4.25	0.20	0.046	(0.138)	0.011	0.035
52	4.33	0.23	0.053	(0.138)	0.013	0.040
53	4.42	0.23	0.053	(0.137)	0.013	0.040
54	4.50	0.23	0.053	(0.137)	0.013	0.040
55	4.58	0.23	0.053	(0.136)	0.013	0.040
56	4.67	0.23	0.053	(0.135)	0.013	0.040
57	4.75	0.23	0.053	(0.135)	0.013	0.040
58	4.83	0.27	0.061	(0.134)	0.015	0.046
59	4.92	0.27	0.061	(0.134)	0.015	0.046
60	5.00	0.27	0.061	(0.133)	0.015	0.046
61	5.08	0.20	0.046	(0.133)	0.011	0.035
62	5.17	0.20	0.046	(0.132)	0.011	0.035
63	5.25	0.20	0.046	(0.131)	0.011	0.035
64	5.33	0.23	0.053	(0.131)	0.013	0.040
65	5.42	0.23	0.053	(0.130)	0.013	0.040
66	5.50	0.23	0.053	(0.130)	0.013	0.040
67	5.58	0.27	0.061	(0.129)	0.015	0.046
68	5.67	0.27	0.061	(0.129)	0.015	0.046
69	5.75	0.27	0.061	(0.128)	0.015	0.046
70	5.83	0.27	0.061	(0.127)	0.015	0.046
71	5.92	0.27	0.061	(0.127)	0.015	0.046
72	6.00	0.27	0.061	(0.126)	0.015	0.046
73	6.08	0.30	0.068	(0.126)	0.016	0.052
74	6.17	0.30	0.068	(0.125)	0.016	0.052
75	6.25	0.30	0.068	(0.125)	0.016	0.052
76	6.33	0.30	0.068	(0.124)	0.016	0.052

77	6.42	0.30	0.068	(0.123)	0.016	0.052
78	6.50	0.30	0.068	(0.123)	0.016	0.052
79	6.58	0.33	0.076	(0.122)	0.018	0.058
80	6.67	0.33	0.076	(0.122)	0.018	0.058
81	6.75	0.33	0.076	(0.121)	0.018	0.058
82	6.83	0.33	0.076	(0.121)	0.018	0.058
83	6.92	0.33	0.076	(0.120)	0.018	0.058
84	7.00	0.33	0.076	(0.120)	0.018	0.058
85	7.08	0.33	0.076	(0.119)	0.018	0.058
86	7.17	0.33	0.076	(0.119)	0.018	0.058
87	7.25	0.33	0.076	(0.118)	0.018	0.058
88	7.33	0.37	0.084	(0.117)	0.020	0.064
89	7.42	0.37	0.084	(0.117)	0.020	0.064
90	7.50	0.37	0.084	(0.116)	0.020	0.064
91	7.58	0.40	0.091	(0.116)	0.022	0.069
92	7.67	0.40	0.091	(0.115)	0.022	0.069
93	7.75	0.40	0.091	(0.115)	0.022	0.069
94	7.83	0.43	0.099	(0.114)	0.024	0.075
95	7.92	0.43	0.099	(0.114)	0.024	0.075
96	8.00	0.43	0.099	(0.113)	0.024	0.075
97	8.08	0.50	0.114	(0.113)	0.027	0.087
98	8.17	0.50	0.114	(0.112)	0.027	0.087
99	8.25	0.50	0.114	(0.112)	0.027	0.087
100	8.33	0.50	0.114	(0.111)	0.027	0.087
101	8.42	0.50	0.114	(0.111)	0.027	0.087
102	8.50	0.50	0.114	(0.110)	0.027	0.087
103	8.58	0.53	0.122	(0.110)	0.029	0.093
104	8.67	0.53	0.122	(0.109)	0.029	0.093
105	8.75	0.53	0.122	(0.109)	0.029	0.093
106	8.83	0.57	0.129	(0.108)	0.031	0.098
107	8.92	0.57	0.129	(0.108)	0.031	0.098
108	9.00	0.57	0.129	(0.107)	0.031	0.098
109	9.08	0.63	0.144	(0.106)	0.035	0.110
110	9.17	0.63	0.144	(0.106)	0.035	0.110
111	9.25	0.63	0.144	(0.105)	0.035	0.110
112	9.33	0.67	0.152	(0.105)	0.036	0.116
113	9.42	0.67	0.152	(0.104)	0.036	0.116
114	9.50	0.67	0.152	(0.104)	0.036	0.116
115	9.58	0.70	0.160	(0.103)	0.038	0.121
116	9.67	0.70	0.160	(0.103)	0.038	0.121
117	9.75	0.70	0.160	(0.102)	0.038	0.121
118	9.83	0.73	0.167	(0.102)	0.040	0.127
119	9.92	0.73	0.167	(0.102)	0.040	0.127
120	10.00	0.73	0.167	(0.101)	0.040	0.127
121	10.08	0.50	0.114	(0.101)	0.027	0.087
122	10.17	0.50	0.114	(0.100)	0.027	0.087
123	10.25	0.50	0.114	(0.100)	0.027	0.087
124	10.33	0.50	0.114	(0.099)	0.027	0.087
125	10.42	0.50	0.114	(0.099)	0.027	0.087
126	10.50	0.50	0.114	(0.098)	0.027	0.087
127	10.58	0.67	0.152	(0.098)	0.036	0.116
128	10.67	0.67	0.152	(0.097)	0.036	0.116
129	10.75	0.67	0.152	(0.097)	0.036	0.116
130	10.83	0.67	0.152	(0.096)	0.036	0.116
131	10.92	0.67	0.152	(0.096)	0.036	0.116
132	11.00	0.67	0.152	(0.095)	0.036	0.116
133	11.08	0.63	0.144	(0.095)	0.035	0.110

134	11.17	0.63	0.144	(0.094)	0.035	0.110
135	11.25	0.63	0.144	(0.094)	0.035	0.110
136	11.33	0.63	0.144	(0.093)	0.035	0.110
137	11.42	0.63	0.144	(0.093)	0.035	0.110
138	11.50	0.63	0.144	(0.092)	0.035	0.110
139	11.58	0.57	0.129	(0.092)	0.031	0.098
140	11.67	0.57	0.129	(0.092)	0.031	0.098
141	11.75	0.57	0.129	(0.091)	0.031	0.098
142	11.83	0.60	0.137	(0.091)	0.033	0.104
143	11.92	0.60	0.137	(0.090)	0.033	0.104
144	12.00	0.60	0.137	(0.090)	0.033	0.104
145	12.08	0.83	0.190	(0.089)	0.045	0.145
146	12.17	0.83	0.190	(0.089)	0.045	0.145
147	12.25	0.83	0.190	(0.088)	0.045	0.145
148	12.33	0.87	0.198	(0.088)	0.047	0.150
149	12.42	0.87	0.198	(0.088)	0.047	0.150
150	12.50	0.87	0.198	(0.087)	0.047	0.150
151	12.58	0.93	0.213	(0.087)	0.051	0.162
152	12.67	0.93	0.213	(0.086)	0.051	0.162
153	12.75	0.93	0.213	(0.086)	0.051	0.162
154	12.83	0.97	0.220	(0.085)	0.053	0.168
155	12.92	0.97	0.220	(0.085)	0.053	0.168
156	13.00	0.97	0.220	(0.084)	0.053	0.168
157	13.08	1.13	0.258	(0.084)	0.062	0.197
158	13.17	1.13	0.258	(0.084)	0.062	0.197
159	13.25	1.13	0.258	(0.083)	0.062	0.197
160	13.33	1.13	0.258	(0.083)	0.062	0.197
161	13.42	1.13	0.258	(0.082)	0.062	0.197
162	13.50	1.13	0.258	(0.082)	0.062	0.197
163	13.58	0.77	0.175	(0.082)	0.042	0.133
164	13.67	0.77	0.175	(0.081)	0.042	0.133
165	13.75	0.77	0.175	(0.081)	0.042	0.133
166	13.83	0.77	0.175	(0.080)	0.042	0.133
167	13.92	0.77	0.175	(0.080)	0.042	0.133
168	14.00	0.77	0.175	(0.079)	0.042	0.133
169	14.08	0.90	0.205	(0.079)	0.049	0.156
170	14.17	0.90	0.205	(0.079)	0.049	0.156
171	14.25	0.90	0.205	(0.078)	0.049	0.156
172	14.33	0.87	0.198	(0.078)	0.047	0.150
173	14.42	0.87	0.198	(0.077)	0.047	0.150
174	14.50	0.87	0.198	(0.077)	0.047	0.150
175	14.58	0.87	0.198	(0.077)	0.047	0.150
176	14.67	0.87	0.198	(0.076)	0.047	0.150
177	14.75	0.87	0.198	(0.076)	0.047	0.150
178	14.83	0.83	0.190	(0.075)	0.045	0.145
179	14.92	0.83	0.190	(0.075)	0.045	0.145
180	15.00	0.83	0.190	(0.075)	0.045	0.145
181	15.08	0.80	0.182	(0.074)	0.044	0.139
182	15.17	0.80	0.182	(0.074)	0.044	0.139
183	15.25	0.80	0.182	(0.074)	0.044	0.139
184	15.33	0.77	0.175	(0.073)	0.042	0.133
185	15.42	0.77	0.175	(0.073)	0.042	0.133
186	15.50	0.77	0.175	(0.072)	0.042	0.133
187	15.58	0.63	0.144	(0.072)	0.035	0.110
188	15.67	0.63	0.144	(0.072)	0.035	0.110
189	15.75	0.63	0.144	(0.071)	0.035	0.110
190	15.83	0.63	0.144	(0.071)	0.035	0.110

191	15.92	0.63	0.144	(0.071)	0.035	0.110
192	16.00	0.63	0.144	(0.070)	0.035	0.110
193	16.08	0.13	0.030	(0.070)	0.007	0.023
194	16.17	0.13	0.030	(0.070)	0.007	0.023
195	16.25	0.13	0.030	(0.069)	0.007	0.023
196	16.33	0.13	0.030	(0.069)	0.007	0.023
197	16.42	0.13	0.030	(0.068)	0.007	0.023
198	16.50	0.13	0.030	(0.068)	0.007	0.023
199	16.58	0.10	0.023	(0.068)	0.005	0.017
200	16.67	0.10	0.023	(0.067)	0.005	0.017
201	16.75	0.10	0.023	(0.067)	0.005	0.017
202	16.83	0.10	0.023	(0.067)	0.005	0.017
203	16.92	0.10	0.023	(0.066)	0.005	0.017
204	17.00	0.10	0.023	(0.066)	0.005	0.017
205	17.08	0.17	0.038	(0.066)	0.009	0.029
206	17.17	0.17	0.038	(0.065)	0.009	0.029
207	17.25	0.17	0.038	(0.065)	0.009	0.029
208	17.33	0.17	0.038	(0.065)	0.009	0.029
209	17.42	0.17	0.038	(0.064)	0.009	0.029
210	17.50	0.17	0.038	(0.064)	0.009	0.029
211	17.58	0.17	0.038	(0.064)	0.009	0.029
212	17.67	0.17	0.038	(0.063)	0.009	0.029
213	17.75	0.17	0.038	(0.063)	0.009	0.029
214	17.83	0.13	0.030	(0.063)	0.007	0.023
215	17.92	0.13	0.030	(0.063)	0.007	0.023
216	18.00	0.13	0.030	(0.062)	0.007	0.023
217	18.08	0.13	0.030	(0.062)	0.007	0.023
218	18.17	0.13	0.030	(0.062)	0.007	0.023
219	18.25	0.13	0.030	(0.061)	0.007	0.023
220	18.33	0.13	0.030	(0.061)	0.007	0.023
221	18.42	0.13	0.030	(0.061)	0.007	0.023
222	18.50	0.13	0.030	(0.060)	0.007	0.023
223	18.58	0.10	0.023	(0.060)	0.005	0.017
224	18.67	0.10	0.023	(0.060)	0.005	0.017
225	18.75	0.10	0.023	(0.060)	0.005	0.017
226	18.83	0.07	0.015	(0.059)	0.004	0.012
227	18.92	0.07	0.015	(0.059)	0.004	0.012
228	19.00	0.07	0.015	(0.059)	0.004	0.012
229	19.08	0.10	0.023	(0.058)	0.005	0.017
230	19.17	0.10	0.023	(0.058)	0.005	0.017
231	19.25	0.10	0.023	(0.058)	0.005	0.017
232	19.33	0.13	0.030	(0.058)	0.007	0.023
233	19.42	0.13	0.030	(0.057)	0.007	0.023
234	19.50	0.13	0.030	(0.057)	0.007	0.023
235	19.58	0.10	0.023	(0.057)	0.005	0.017
236	19.67	0.10	0.023	(0.057)	0.005	0.017
237	19.75	0.10	0.023	(0.056)	0.005	0.017
238	19.83	0.07	0.015	(0.056)	0.004	0.012
239	19.92	0.07	0.015	(0.056)	0.004	0.012
240	20.00	0.07	0.015	(0.056)	0.004	0.012
241	20.08	0.10	0.023	(0.055)	0.005	0.017
242	20.17	0.10	0.023	(0.055)	0.005	0.017
243	20.25	0.10	0.023	(0.055)	0.005	0.017
244	20.33	0.10	0.023	(0.055)	0.005	0.017
245	20.42	0.10	0.023	(0.054)	0.005	0.017
246	20.50	0.10	0.023	(0.054)	0.005	0.017
247	20.58	0.10	0.023	(0.054)	0.005	0.017

248	20.67	0.10	0.023	(0.054)	0.005	0.017
249	20.75	0.10	0.023	(0.053)	0.005	0.017
250	20.83	0.07	0.015	(0.053)	0.004	0.012
251	20.92	0.07	0.015	(0.053)	0.004	0.012
252	21.00	0.07	0.015	(0.053)	0.004	0.012
253	21.08	0.10	0.023	(0.053)	0.005	0.017
254	21.17	0.10	0.023	(0.052)	0.005	0.017
255	21.25	0.10	0.023	(0.052)	0.005	0.017
256	21.33	0.07	0.015	(0.052)	0.004	0.012
257	21.42	0.07	0.015	(0.052)	0.004	0.012
258	21.50	0.07	0.015	(0.052)	0.004	0.012
259	21.58	0.10	0.023	(0.051)	0.005	0.017
260	21.67	0.10	0.023	(0.051)	0.005	0.017
261	21.75	0.10	0.023	(0.051)	0.005	0.017
262	21.83	0.07	0.015	(0.051)	0.004	0.012
263	21.92	0.07	0.015	(0.051)	0.004	0.012
264	22.00	0.07	0.015	(0.051)	0.004	0.012
265	22.08	0.10	0.023	(0.050)	0.005	0.017
266	22.17	0.10	0.023	(0.050)	0.005	0.017
267	22.25	0.10	0.023	(0.050)	0.005	0.017
268	22.33	0.07	0.015	(0.050)	0.004	0.012
269	22.42	0.07	0.015	(0.050)	0.004	0.012
270	22.50	0.07	0.015	(0.050)	0.004	0.012
271	22.58	0.07	0.015	(0.049)	0.004	0.012
272	22.67	0.07	0.015	(0.049)	0.004	0.012
273	22.75	0.07	0.015	(0.049)	0.004	0.012
274	22.83	0.07	0.015	(0.049)	0.004	0.012
275	22.92	0.07	0.015	(0.049)	0.004	0.012
276	23.00	0.07	0.015	(0.049)	0.004	0.012
277	23.08	0.07	0.015	(0.049)	0.004	0.012
278	23.17	0.07	0.015	(0.049)	0.004	0.012
279	23.25	0.07	0.015	(0.048)	0.004	0.012
280	23.33	0.07	0.015	(0.048)	0.004	0.012
281	23.42	0.07	0.015	(0.048)	0.004	0.012
282	23.50	0.07	0.015	(0.048)	0.004	0.012
283	23.58	0.07	0.015	(0.048)	0.004	0.012
284	23.67	0.07	0.015	(0.048)	0.004	0.012
285	23.75	0.07	0.015	(0.048)	0.004	0.012
286	23.83	0.07	0.015	(0.048)	0.004	0.012
287	23.92	0.07	0.015	(0.048)	0.004	0.012
288	24.00	0.07	0.015	(0.048)	0.004	0.012

(Loss Rate Not Used)

Sum = 100.0 Sum = 17.3

Flood volume = Effective rainfall 1.45(In)
times area 2.6(Ac.)/[(In)/(Ft.)] = 0.3(Ac.Ft)
Total soil loss = 0.45(In)
Total soil loss = 0.099(Ac.Ft)
Total rainfall = 1.90(In)
Flood volume = 13695.2 Cubic Feet
Total soil loss = 4305.9 Cubic Feet

Peak flow rate of this hydrograph = 0.517(CFS)

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24 - H O U R S T O R M

R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0001	0.02	Q				
0+10	0.0003	0.03	Q				
0+15	0.0006	0.03	Q				
0+20	0.0008	0.04	Q				
0+25	0.0011	0.05	Q				
0+30	0.0015	0.05	Q				
0+35	0.0018	0.05	Q				
0+40	0.0021	0.05	Q				
0+45	0.0024	0.05	Q				
0+50	0.0028	0.06	Q				
0+55	0.0032	0.06	Q				
1+ 0	0.0036	0.06	Q				
1+ 5	0.0040	0.05	Q				
1+10	0.0043	0.05	Q				
1+15	0.0046	0.05	Q				
1+20	0.0049	0.05	Q				
1+25	0.0052	0.05	Q				
1+30	0.0055	0.05	Q				
1+35	0.0059	0.05	Q				
1+40	0.0062	0.05	Q				
1+45	0.0065	0.05	Q				
1+50	0.0069	0.06	Q				
1+55	0.0073	0.06	Q				
2+ 0	0.0077	0.06	Q				
2+ 5	0.0081	0.06	QV				
2+10	0.0086	0.06	QV				
2+15	0.0090	0.06	QV				
2+20	0.0094	0.06	QV				
2+25	0.0098	0.06	QV				
2+30	0.0102	0.06	QV				
2+35	0.0107	0.07	QV				
2+40	0.0112	0.08	QV				
2+45	0.0118	0.08	QV				
2+50	0.0123	0.08	QV				
2+55	0.0128	0.08	QV				
3+ 0	0.0133	0.08	QV				
3+ 5	0.0139	0.08	QV				
3+10	0.0144	0.08	QV				
3+15	0.0149	0.08	QV				
3+20	0.0154	0.08	QV				
3+25	0.0160	0.08	Q V				
3+30	0.0165	0.08	Q V				
3+35	0.0170	0.08	Q V				
3+40	0.0175	0.08	Q V				
3+45	0.0181	0.08	Q V				
3+50	0.0186	0.09	Q V				
3+55	0.0193	0.09	Q V				
4+ 0	0.0199	0.09	Q V				
4+ 5	0.0205	0.09	Q V				
4+10	0.0212	0.09	Q V				
4+15	0.0218	0.09	Q V				
4+20	0.0225	0.10	Q V				

4+25	0.0232	0.11	Q V	|	|	|	|
4+30	0.0240	0.11	Q V	|	|	|	|
4+35	0.0247	0.11	Q V	|	|	|	|
4+40	0.0254	0.11	Q V	|	|	|	|
4+45	0.0262	0.11	Q V	|	|	|	|
4+50	0.0270	0.12	Q V	|	|	|	|
4+55	0.0278	0.12	Q V	|	|	|	|
5+ 0	0.0286	0.12	Q V	|	|	|	|
5+ 5	0.0293	0.10	Q V	|	|	|	|
5+10	0.0300	0.09	Q V	|	|	|	|
5+15	0.0306	0.09	Q V	|	|	|	|
5+20	0.0313	0.10	Q V	|	|	|	|
5+25	0.0320	0.11	Q V	|	|	|	|
5+30	0.0328	0.11	Q V	|	|	|	|
5+35	0.0336	0.12	Q V	|	|	|	|
5+40	0.0344	0.12	Q V	|	|	|	|
5+45	0.0352	0.12	Q V	|	|	|	|
5+50	0.0361	0.12	Q V	|	|	|	|
5+55	0.0369	0.12	Q V	|	|	|	|
6+ 0	0.0377	0.12	Q V	|	|	|	|
6+ 5	0.0387	0.13	Q V	|	|	|	|
6+10	0.0396	0.14	Q V	|	|	|	|
6+15	0.0405	0.14	Q V	|	|	|	|
6+20	0.0415	0.14	Q V	|	|	|	|
6+25	0.0424	0.14	Q V	|	|	|	|
6+30	0.0434	0.14	Q V	|	|	|	|
6+35	0.0444	0.15	Q V	|	|	|	|
6+40	0.0454	0.15	Q V	|	|	|	|
6+45	0.0465	0.15	Q V	|	|	|	|
6+50	0.0475	0.15	Q V	|	|	|	|
6+55	0.0486	0.15	Q V	|	|	|	|
7+ 0	0.0496	0.15	Q V	|	|	|	|
7+ 5	0.0507	0.15	Q V	|	|	|	|
7+10	0.0517	0.15	Q V	|	|	|	|
7+15	0.0528	0.15	Q V	|	|	|	|
7+20	0.0539	0.16	Q V	|	|	|	|
7+25	0.0550	0.17	Q V	|	|	|	|
7+30	0.0562	0.17	Q V	|	|	|	|
7+35	0.0574	0.18	Q V	|	|	|	|
7+40	0.0587	0.18	Q V	|	|	|	|
7+45	0.0599	0.18	Q V	|	|	|	|
7+50	0.0613	0.19	Q V	|	|	|	|
7+55	0.0626	0.20	Q V	|	|	|	|
8+ 0	0.0640	0.20	Q V	|	|	|	|
8+ 5	0.0655	0.22	Q V	|	|	|	|
8+10	0.0670	0.23	Q V	|	|	|	|
8+15	0.0686	0.23	Q V	|	|	|	|
8+20	0.0702	0.23	Q V	|	|	|	|
8+25	0.0718	0.23	Q V	|	|	|	|
8+30	0.0733	0.23	Q V	|	|	|	|
8+35	0.0750	0.24	Q V	|	|	|	|
8+40	0.0767	0.24	Q V	|	|	|	|
8+45	0.0783	0.24	Q V	|	|	|	|
8+50	0.0801	0.25	| Q V	|	|	|	|
8+55	0.0819	0.26	| Q V	|	|	|	|
9+ 0	0.0836	0.26	| Q V	|	|	|	|
9+ 5	0.0856	0.28	| Q V	|	|	|	|

9+10	0.0875	0.29	Q	V			
9+15	0.0895	0.29	Q	V			
9+20	0.0916	0.30	Q	V			
9+25	0.0937	0.30	Q	V			
9+30	0.0958	0.30	Q	V			
9+35	0.0980	0.31	Q	V			
9+40	0.1002	0.32	Q	V			
9+45	0.1024	0.32	Q	V			
9+50	0.1046	0.33	Q	V			
9+55	0.1069	0.33	Q	V			
10+ 0	0.1092	0.33	Q	V			
10+ 5	0.1111	0.27	Q	V			
10+10	0.1126	0.23	Q	V			
10+15	0.1142	0.23	Q	V			
10+20	0.1158	0.23	Q	V			
10+25	0.1174	0.23	Q	V			
10+30	0.1189	0.23	Q	V			
10+35	0.1208	0.28	Q	V			
10+40	0.1229	0.30	Q	V			
10+45	0.1250	0.30	Q	V			
10+50	0.1271	0.30	Q	V			
10+55	0.1292	0.30	Q	V			
11+ 0	0.1313	0.30	Q	V			
11+ 5	0.1333	0.29	Q	V			
11+10	0.1353	0.29	Q	V			
11+15	0.1373	0.29	Q	V			
11+20	0.1393	0.29	Q	V			
11+25	0.1413	0.29	Q	V			
11+30	0.1433	0.29	Q	V			
11+35	0.1452	0.27	Q	V			
11+40	0.1469	0.26	Q	V			
11+45	0.1487	0.26	Q	V			
11+50	0.1506	0.27	Q	V			
11+55	0.1525	0.27	Q	V			
12+ 0	0.1543	0.27	Q	V			
12+ 5	0.1567	0.34	Q	V			
12+10	0.1593	0.38	Q	V			
12+15	0.1619	0.38	Q	V			
12+20	0.1646	0.39	Q	V			
12+25	0.1674	0.40	Q	V			
12+30	0.1701	0.40	Q	V			
12+35	0.1729	0.42	Q	V			
12+40	0.1759	0.43	Q	V			
12+45	0.1788	0.43	Q	V			
12+50	0.1818	0.44	Q	V			
12+55	0.1849	0.44	Q	V			
13+ 0	0.1879	0.44	Q	V			
13+ 5	0.1913	0.49	Q	V			
13+10	0.1948	0.52	Q	V			
13+15	0.1984	0.52	Q	V			
13+20	0.2020	0.52	Q	V			
13+25	0.2055	0.52	Q	V			
13+30	0.2091	0.52	Q	V			
13+35	0.2119	0.41	Q	V			
13+40	0.2143	0.35	Q	V			
13+45	0.2167	0.35	Q	V			
13+50	0.2191	0.35	Q	V			

13+55	0.2215	0.35	Q			V	
14+ 0	0.2240	0.35	Q			V	
14+ 5	0.2266	0.39	Q			V	
14+10	0.2295	0.41	Q			V	
14+15	0.2323	0.41	Q			V	
14+20	0.2351	0.40	Q			V	
14+25	0.2378	0.40	Q			V	
14+30	0.2405	0.40	Q			V	
14+35	0.2432	0.40	Q			V	
14+40	0.2460	0.40	Q			V	
14+45	0.2487	0.40	Q			V	
14+50	0.2513	0.39	Q			V	
14+55	0.2540	0.38	Q			V	
15+ 0	0.2566	0.38	Q			V	
15+ 5	0.2591	0.37	Q			V	
15+10	0.2616	0.37	Q			V	
15+15	0.2642	0.37	Q			V	
15+20	0.2666	0.36	Q			V	
15+25	0.2690	0.35	Q			V	
15+30	0.2714	0.35	Q			V	
15+35	0.2736	0.31	Q			V	
15+40	0.2756	0.29	Q			V	
15+45	0.2775	0.29	Q			V	
15+50	0.2795	0.29	Q			V	
15+55	0.2815	0.29	Q			V	
16+ 0	0.2835	0.29	Q			V	
16+ 5	0.2845	0.14	Q			V	
16+10	0.2849	0.06	Q			V	
16+15	0.2853	0.06	Q			V	
16+20	0.2857	0.06	Q			V	
16+25	0.2862	0.06	Q			V	
16+30	0.2866	0.06	Q			V	
16+35	0.2869	0.05	Q			V	
16+40	0.2873	0.05	Q			V	
16+45	0.2876	0.05	Q			V	
16+50	0.2879	0.05	Q			V	
16+55	0.2882	0.05	Q			V	
17+ 0	0.2885	0.05	Q			V	
17+ 5	0.2890	0.07	Q			V	
17+10	0.2895	0.08	Q			V	
17+15	0.2900	0.08	Q			V	
17+20	0.2905	0.08	Q			V	
17+25	0.2911	0.08	Q			V	
17+30	0.2916	0.08	Q			V	
17+35	0.2921	0.08	Q			V	
17+40	0.2926	0.08	Q			V	
17+45	0.2932	0.08	Q			V	
17+50	0.2936	0.07	Q			V	
17+55	0.2940	0.06	Q			V	
18+ 0	0.2944	0.06	Q			V	
18+ 5	0.2949	0.06	Q			V	
18+10	0.2953	0.06	Q			V	
18+15	0.2957	0.06	Q			V	
18+20	0.2961	0.06	Q			V	
18+25	0.2965	0.06	Q			V	
18+30	0.2970	0.06	Q			V	
18+35	0.2973	0.05	Q			V	

18+40	0.2976	0.05	Q	|	|	|	V |
18+45	0.2979	0.05	Q	|	|	|	V |
18+50	0.2982	0.04	Q	|	|	|	V |
18+55	0.2984	0.03	Q	|	|	|	V |
19+ 0	0.2986	0.03	Q	|	|	|	V |
19+ 5	0.2989	0.04	Q	|	|	|	V |
19+10	0.2992	0.05	Q	|	|	|	V |
19+15	0.2995	0.05	Q	|	|	|	V |
19+20	0.2999	0.06	Q	|	|	|	V |
19+25	0.3003	0.06	Q	|	|	|	V |
19+30	0.3007	0.06	Q	|	|	|	V |
19+35	0.3011	0.05	Q	|	|	|	V |
19+40	0.3014	0.05	Q	|	|	|	V |
19+45	0.3017	0.05	Q	|	|	|	V |
19+50	0.3020	0.04	Q	|	|	|	V |
19+55	0.3022	0.03	Q	|	|	|	V |
20+ 0	0.3024	0.03	Q	|	|	|	V |
20+ 5	0.3027	0.04	Q	|	|	|	V |
20+10	0.3030	0.05	Q	|	|	|	V |
20+15	0.3033	0.05	Q	|	|	|	V |
20+20	0.3036	0.05	Q	|	|	|	V |
20+25	0.3039	0.05	Q	|	|	|	V |
20+30	0.3042	0.05	Q	|	|	|	V |
20+35	0.3045	0.05	Q	|	|	|	V |
20+40	0.3049	0.05	Q	|	|	|	V |
20+45	0.3052	0.05	Q	|	|	|	V |
20+50	0.3054	0.04	Q	|	|	|	V |
20+55	0.3056	0.03	Q	|	|	|	V |
21+ 0	0.3058	0.03	Q	|	|	|	V |
21+ 5	0.3061	0.04	Q	|	|	|	V |
21+10	0.3064	0.05	Q	|	|	|	V |
21+15	0.3067	0.05	Q	|	|	|	V|
21+20	0.3070	0.04	Q	|	|	|	V|
21+25	0.3072	0.03	Q	|	|	|	V|
21+30	0.3074	0.03	Q	|	|	|	V|
21+35	0.3077	0.04	Q	|	|	|	V|
21+40	0.3080	0.05	Q	|	|	|	V|
21+45	0.3083	0.05	Q	|	|	|	V|
21+50	0.3086	0.04	Q	|	|	|	V|
21+55	0.3088	0.03	Q	|	|	|	V|
22+ 0	0.3090	0.03	Q	|	|	|	V|
22+ 5	0.3093	0.04	Q	|	|	|	V|
22+10	0.3096	0.05	Q	|	|	|	V|
22+15	0.3099	0.05	Q	|	|	|	V|
22+20	0.3101	0.04	Q	|	|	|	V|
22+25	0.3103	0.03	Q	|	|	|	V|
22+30	0.3106	0.03	Q	|	|	|	V|
22+35	0.3108	0.03	Q	|	|	|	V|
22+40	0.3110	0.03	Q	|	|	|	V|
22+45	0.3112	0.03	Q	|	|	|	V|
22+50	0.3114	0.03	Q	|	|	|	V|
22+55	0.3116	0.03	Q	|	|	|	V|
23+ 0	0.3118	0.03	Q	|	|	|	V|
23+ 5	0.3120	0.03	Q	|	|	|	V|
23+10	0.3122	0.03	Q	|	|	|	V|
23+15	0.3124	0.03	Q	|	|	|	V|
23+20	0.3126	0.03	Q	|	|	|	V|

23+25	0.3129	0.03	Q	|	|	|	V|
23+30	0.3131	0.03	Q	|	|	|	V|
23+35	0.3133	0.03	Q	|	|	|	V|
23+40	0.3135	0.03	Q	|	|	|	V|
23+45	0.3137	0.03	Q	|	|	|	V|
23+50	0.3139	0.03	Q	|	|	|	V|
23+55	0.3141	0.03	Q	|	|	|	V|
24+ 0	0.3143	0.03	Q	|	|	|	V|
24+ 5	0.3144	0.01	Q	|	|	|	V|

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	Manual	------	-------	0.520	-------	-------	0.950	-------	-------	1.750	inflow hydrograph
2	Diversion1	1	-------	0.065	-------	-------	0.065	-------	-------	0.065	Infiltration
3	Diversion2	1	-------	0.455	-------	-------	0.885	-------	-------	1.685	Detention
5	Reservoir	3	-------	0.000	-------	-------	0.741	-------	-------	1.592	Perforated Pipe

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

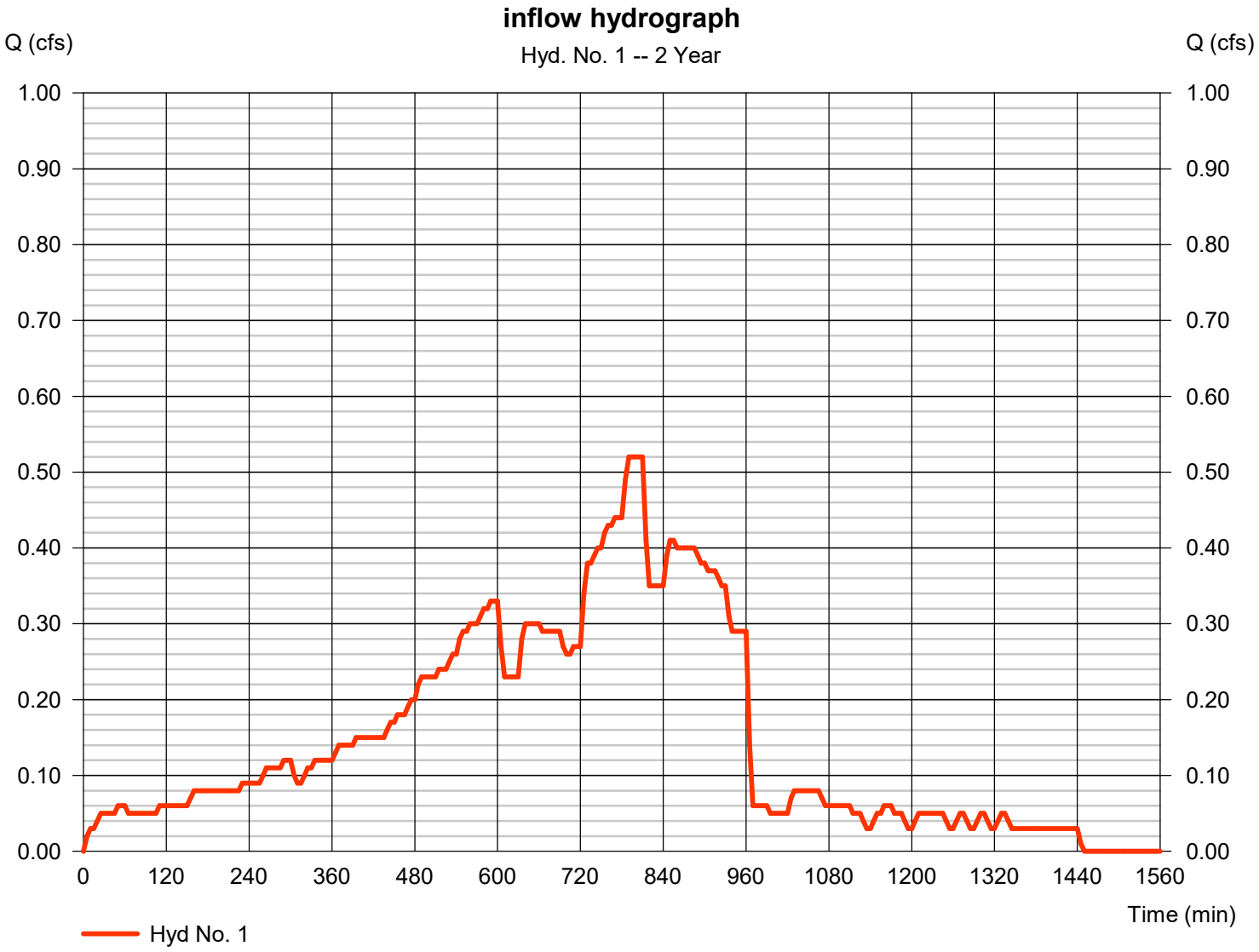
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Manual	0.520	5	790	13,791	------	------	------	inflow hydrograph
2	Diversion1	0.065	5	475	4,969	1	------	------	Infiltration
3	Diversion2	0.455	5	790	8,822	1	------	------	Detention
5	Reservoir	0.000	5	n/a	0	3	102.20	8,822	Perforated Pipe

Hydrograph Report

Hyd. No. 1

inflow hydrograph

Hydrograph type	= Manual	Peak discharge	= 0.520 cfs
Storm frequency	= 2 yrs	Time to peak	= 790 min
Time interval	= 5 min	Hyd. volume	= 13,791 cuft

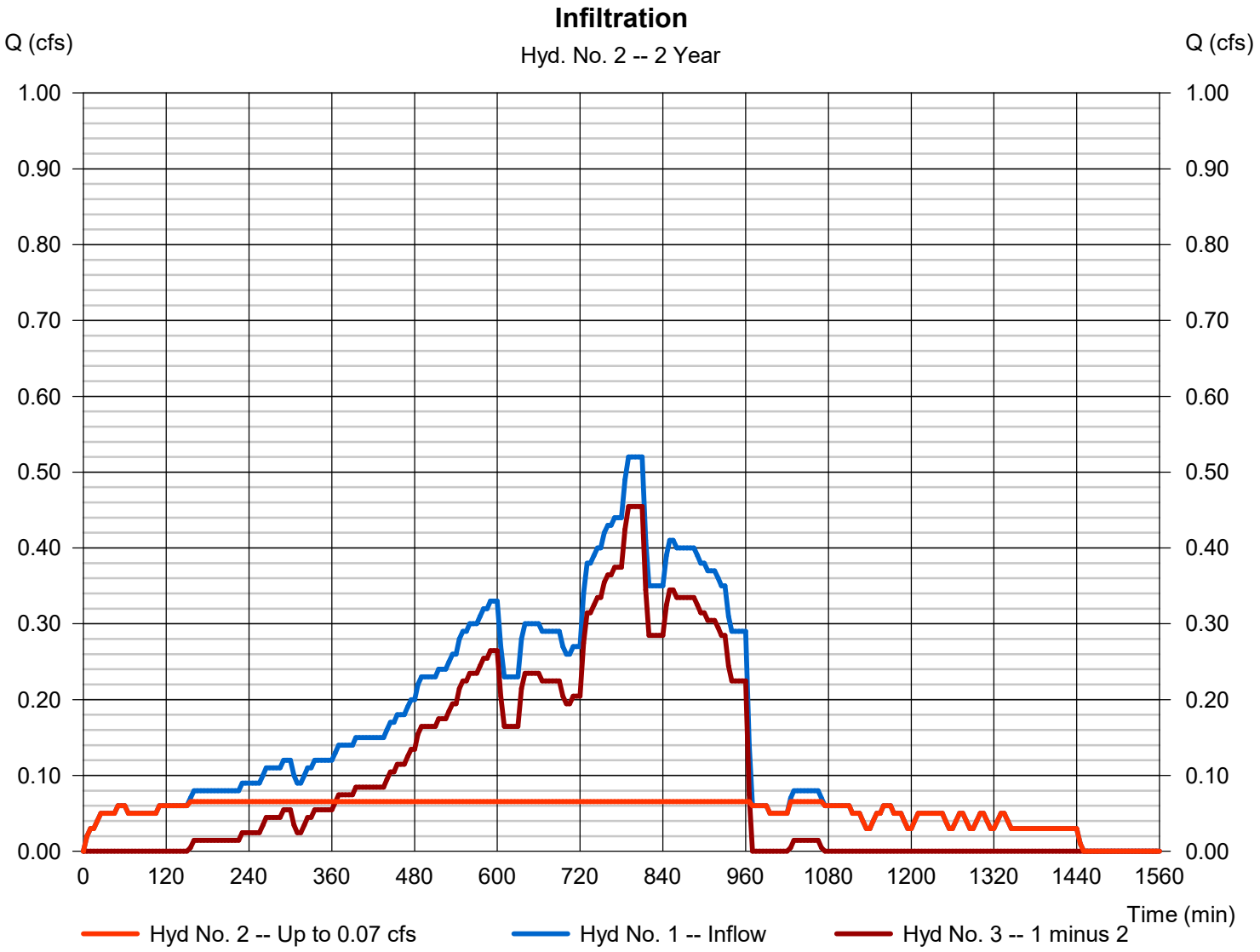


Hydrograph Report

Hyd. No. 2

Infiltration

Hydrograph type	= Diversion1	Peak discharge	= 0.065 cfs
Storm frequency	= 2 yrs	Time to peak	= 475 min
Time interval	= 5 min	Hyd. volume	= 4,969 cuft
Inflow hydrograph	= 1 - inflow hydrograph	2nd diverted hyd.	= 3
Diversion method	= Constant Q	Constant Q	= 0.07 cfs

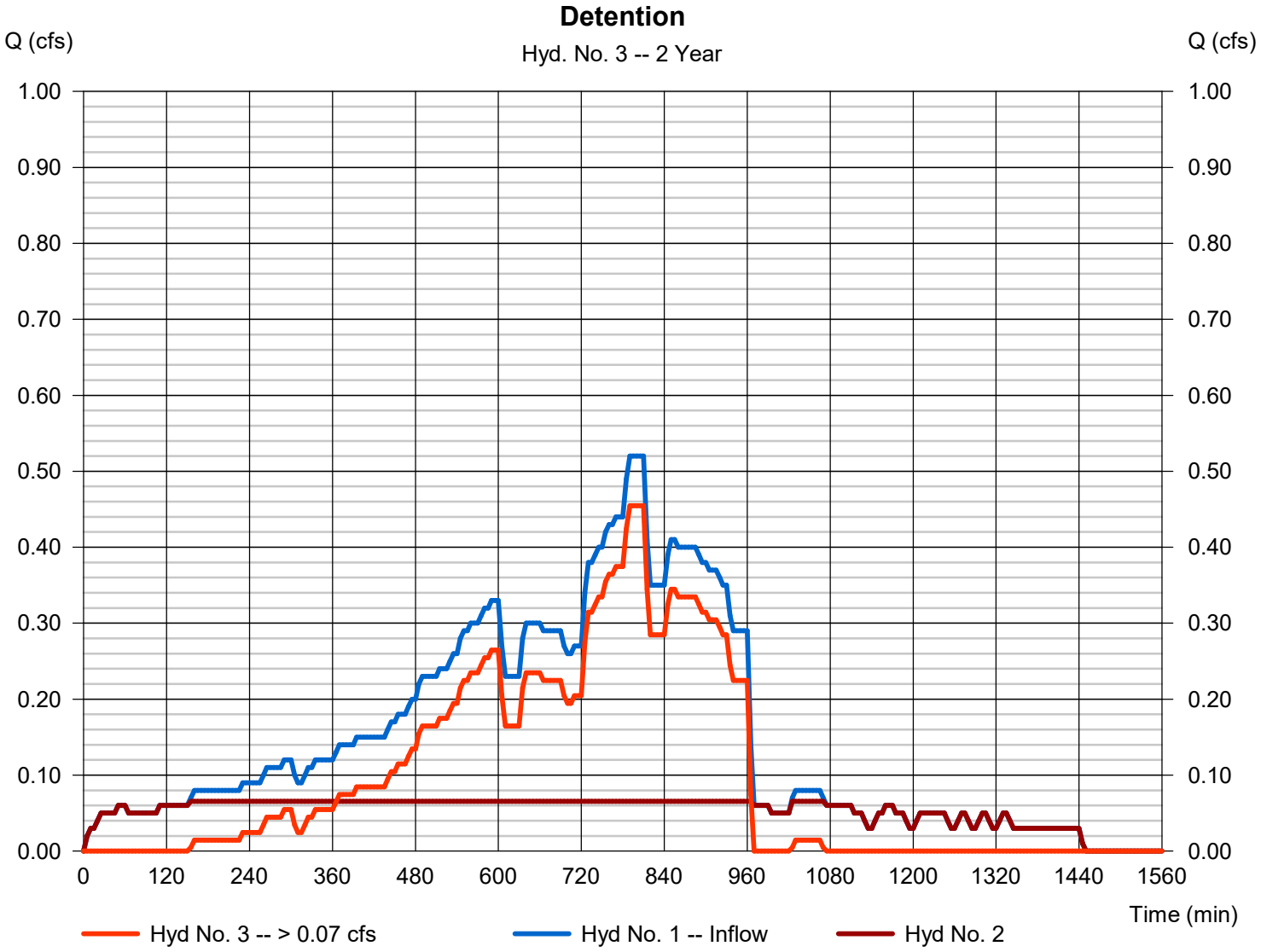


Hydrograph Report

Hyd. No. 3

Detention

Hydrograph type	= Diversion2	Peak discharge	= 0.455 cfs
Storm frequency	= 2 yrs	Time to peak	= 790 min
Time interval	= 5 min	Hyd. volume	= 8,822 cuft
Inflow hydrograph	= 1 - inflow hydrograph	2nd diverted hyd.	= 2
Diversion method	= Constant Q	Constant Q	= 0.07 cfs



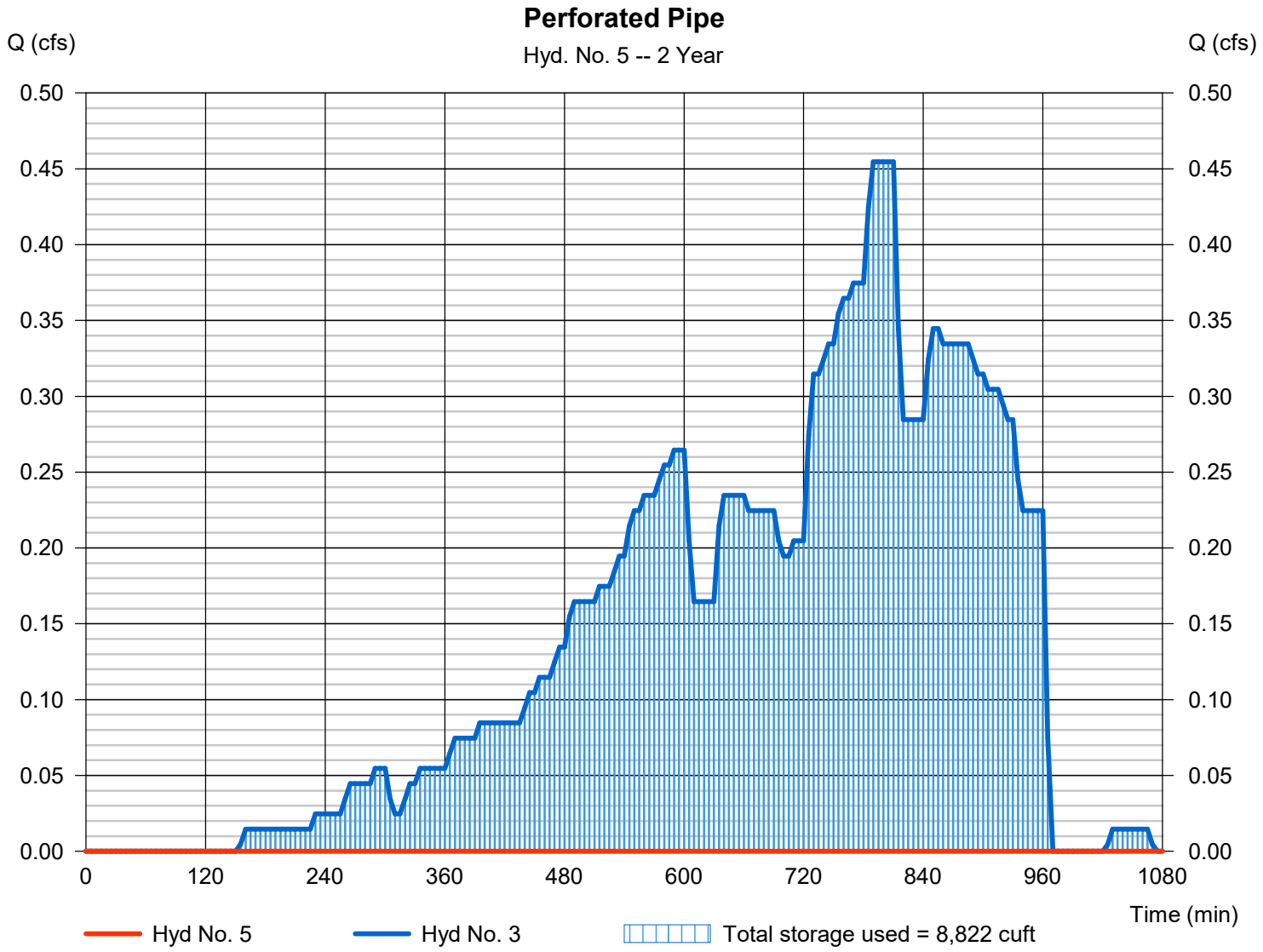
Hydrograph Report

Hyd. No. 5

Perforated Pipe

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	2 yrs	Time to peak	=	n/a
Time interval	=	5 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	3 - Detention	Max. Elevation	=	102.20 ft
Reservoir name	=	Infiltration Basin	Max. Storage	=	8,822 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - Infiltration Basin

Pond Data

UG Chambers -Invert elev. = 100.00 ft, Rise x Span = 3.00 x 3.00 ft, Barrel Len = 145.00 ft, No. Barrels = 7, Slope = 0.01%, Headers = No
Encasement -Invert elev. = 99.50 ft, Width = 5.00 ft, Height = 4.00 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	99.50	n/a	0	0
0.40	99.90	n/a	800	800
0.80	100.30	n/a	1,035	1,835
1.20	100.70	n/a	1,355	3,190
1.61	101.11	n/a	1,484	4,674
2.01	101.51	n/a	1,540	6,214
2.41	101.91	n/a	1,540	7,754
2.81	102.31	n/a	1,484	9,238
3.21	102.71	n/a	1,355	10,593
3.61	103.11	n/a	1,034	11,627
4.01	103.51	n/a	815	12,442

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	Inactive	Inactive	6.00	Inactive
Span (in)	= 3.00	2.00	11.20	0.00
No. Barrels	= 8	1	1	0
Invert El. (ft)	= 102.75	102.75	102.75	0.00
Length (ft)	= 20.00	20.00	20.00	0.00
Slope (%)	= 5.00	5.00	5.00	n/a
N-Value	= .011	.011	.011	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	Inactive	Inactive	Inactive	Inactive
Crest El. (ft)	= 102.73	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No
Exfil.(in/hr)	= 0.000 (by Contour)			
TW Elev. (ft)	= 0.00			

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	99.50	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.04	80	99.54	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.08	160	99.58	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.12	240	99.62	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.16	320	99.66	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.20	400	99.70	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.24	480	99.74	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.28	560	99.78	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.32	640	99.82	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.36	720	99.86	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.40	800	99.90	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.44	904	99.94	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.48	1,007	99.98	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.52	1,111	100.02	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.56	1,214	100.06	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.60	1,318	100.10	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.64	1,421	100.14	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.68	1,525	100.18	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.72	1,628	100.22	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.76	1,732	100.26	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.80	1,835	100.30	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.84	1,971	100.34	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.88	2,106	100.38	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.92	2,242	100.42	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.96	2,377	100.46	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.00	2,513	100.50	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.04	2,648	100.54	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.08	2,784	100.58	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.12	2,919	100.62	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.16	3,054	100.66	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.20	3,190	100.70	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.24	3,338	100.74	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000

Continues on next page...

Infiltration Basin

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
1.28	3,487	100.78	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.32	3,635	100.82	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.36	3,784	100.86	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.41	3,932	100.91	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.45	4,080	100.95	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.49	4,229	100.99	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.53	4,377	101.03	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.57	4,526	101.07	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.61	4,674	101.11	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.65	4,828	101.15	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.69	4,982	101.19	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.73	5,136	101.23	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.77	5,290	101.27	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.81	5,444	101.31	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.85	5,598	101.35	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.89	5,752	101.39	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.93	5,906	101.43	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.97	6,060	101.47	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.01	6,214	101.51	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.05	6,368	101.55	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.09	6,522	101.59	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.13	6,676	101.63	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.17	6,830	101.67	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.21	6,984	101.71	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.25	7,138	101.75	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.29	7,292	101.79	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.33	7,446	101.83	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.37	7,600	101.87	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.41	7,754	101.91	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.45	7,902	101.95	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.49	8,051	101.99	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.53	8,199	102.03	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.57	8,348	102.07	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.61	8,496	102.11	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.65	8,644	102.15	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.69	8,793	102.19	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.73	8,941	102.23	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.77	9,090	102.27	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.81	9,238	102.31	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.85	9,374	102.35	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.89	9,509	102.39	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.93	9,644	102.43	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.97	9,780	102.47	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
3.01	9,915	102.51	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
3.05	10,051	102.55	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
3.09	10,186	102.59	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
3.13	10,322	102.63	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
3.17	10,457	102.67	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
3.21	10,593	102.71	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
3.25	10,696	102.75	0.00	0.00	0.00 ic	---	0.00	---	---	---	---	---	0.000
3.29	10,800	102.79	0.00	0.00	0.03 ic	---	0.00	---	---	---	---	---	0.027
3.33	10,903	102.83	0.00	0.00	0.07 ic	---	0.00	---	---	---	---	---	0.075
3.37	11,006	102.87	0.00	0.00	0.14 ic	---	0.00	---	---	---	---	---	0.136
3.41	11,110	102.91	0.00	0.00	0.21 ic	---	0.00	---	---	---	---	---	0.208
3.45	11,213	102.95	0.00	0.00	0.29 ic	---	0.00	---	---	---	---	---	0.290
3.49	11,317	102.99	0.00	0.00	0.38 ic	---	0.00	---	---	---	---	---	0.380
3.53	11,420	103.03	0.00	0.00	0.48 ic	---	0.00	---	---	---	---	---	0.478
3.57	11,523	103.07	0.00	0.00	0.58 ic	---	0.00	---	---	---	---	---	0.583
3.61	11,627	103.11	0.00	0.00	0.70 ic	---	0.00	---	---	---	---	---	0.695
3.65	11,708	103.15	0.00	0.00	0.81 ic	---	0.00	---	---	---	---	---	0.814
3.69	11,790	103.19	0.00	0.00	0.94 ic	---	0.00	---	---	---	---	---	0.938
3.73	11,871	103.23	0.00	0.00	1.07 ic	---	0.00	---	---	---	---	---	1.068
3.77	11,953	103.27	0.00	0.00	1.18 ic	---	0.00	---	---	---	---	---	1.175
3.81	12,034	103.31	0.00	0.00	1.26 ic	---	0.00	---	---	---	---	---	1.259
3.85	12,116	103.35	0.00	0.00	1.34 ic	---	0.00	---	---	---	---	---	1.337
3.89	12,197	103.39	0.00	0.00	1.41 ic	---	0.00	---	---	---	---	---	1.411
3.93	12,279	103.43	0.00	0.00	1.48 ic	---	0.00	---	---	---	---	---	1.481
3.97	12,360	103.47	0.00	0.00	1.55 ic	---	0.00	---	---	---	---	---	1.548
4.01	12,442	103.51	0.00	0.00	1.61 ic	---	0.00	---	---	---	---	---	1.612

...End

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

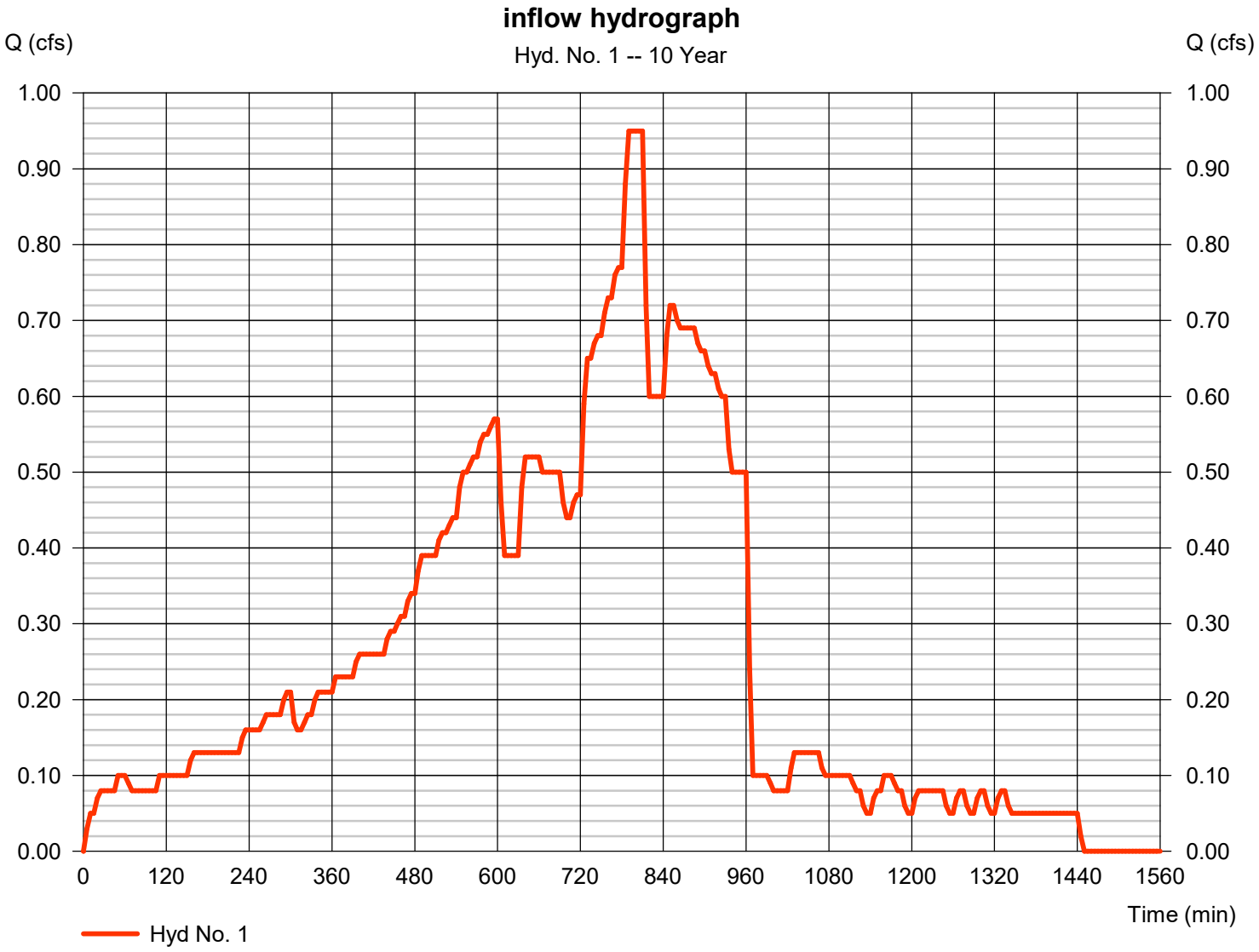
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Manual	0.950	5	790	23,610	------	------	------	inflow hydrograph
2	Diversion1	0.065	5	290	5,488	1	------	------	Infiltration
3	Diversion2	0.885	5	790	18,122	1	------	------	Detention
5	Reservoir	0.741	5	815	7,423	3	103.13	11,658	Perforated Pipe

Hydrograph Report

Hyd. No. 1

inflow hydrograph

Hydrograph type	= Manual	Peak discharge	= 0.950 cfs
Storm frequency	= 10 yrs	Time to peak	= 790 min
Time interval	= 5 min	Hyd. volume	= 23,610 cuft

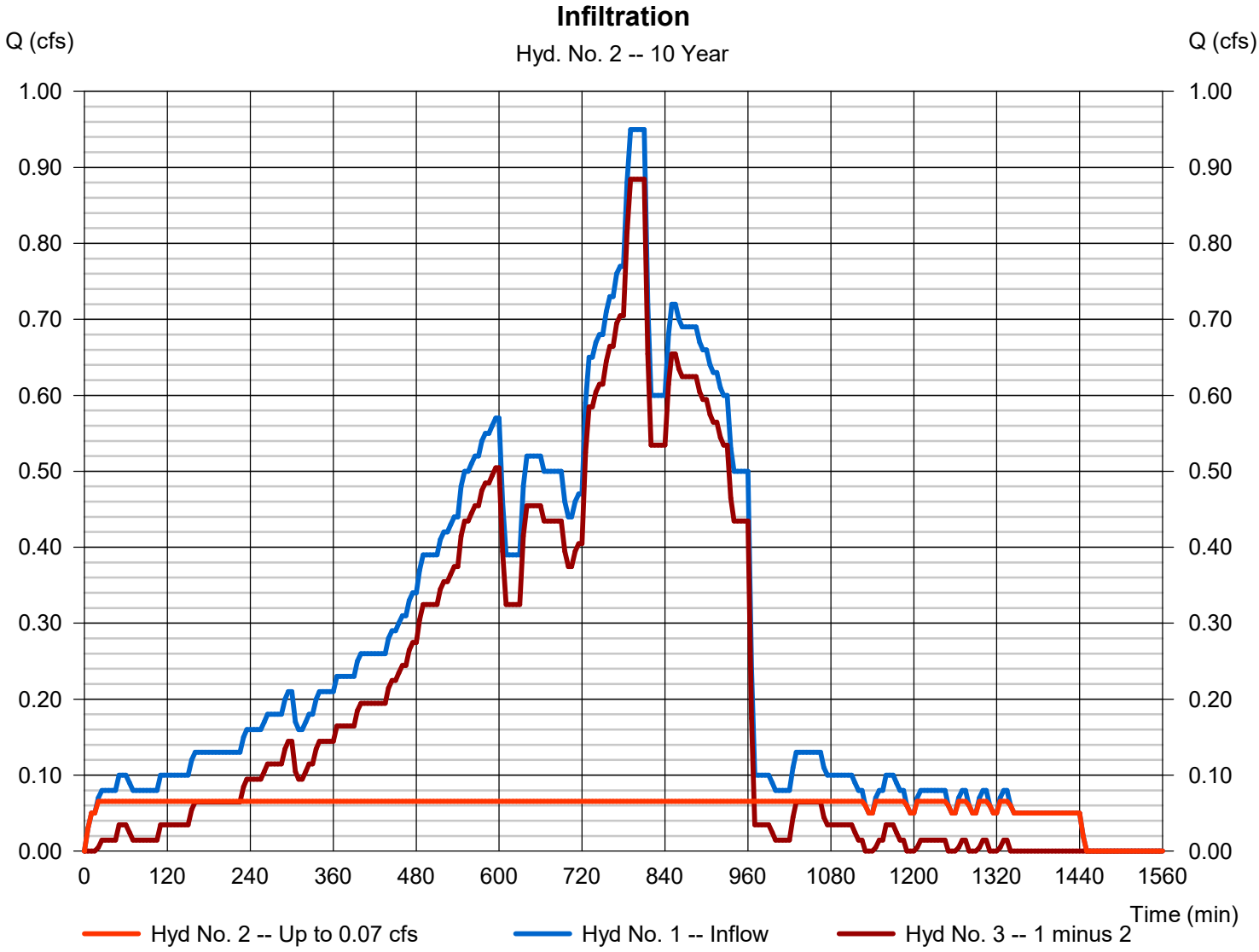


Hydrograph Report

Hyd. No. 2

Infiltration

Hydrograph type	= Diversion1	Peak discharge	= 0.065 cfs
Storm frequency	= 10 yrs	Time to peak	= 290 min
Time interval	= 5 min	Hyd. volume	= 5,488 cuft
Inflow hydrograph	= 1 - inflow hydrograph	2nd diverted hyd.	= 3
Diversion method	= Constant Q	Constant Q	= 0.07 cfs

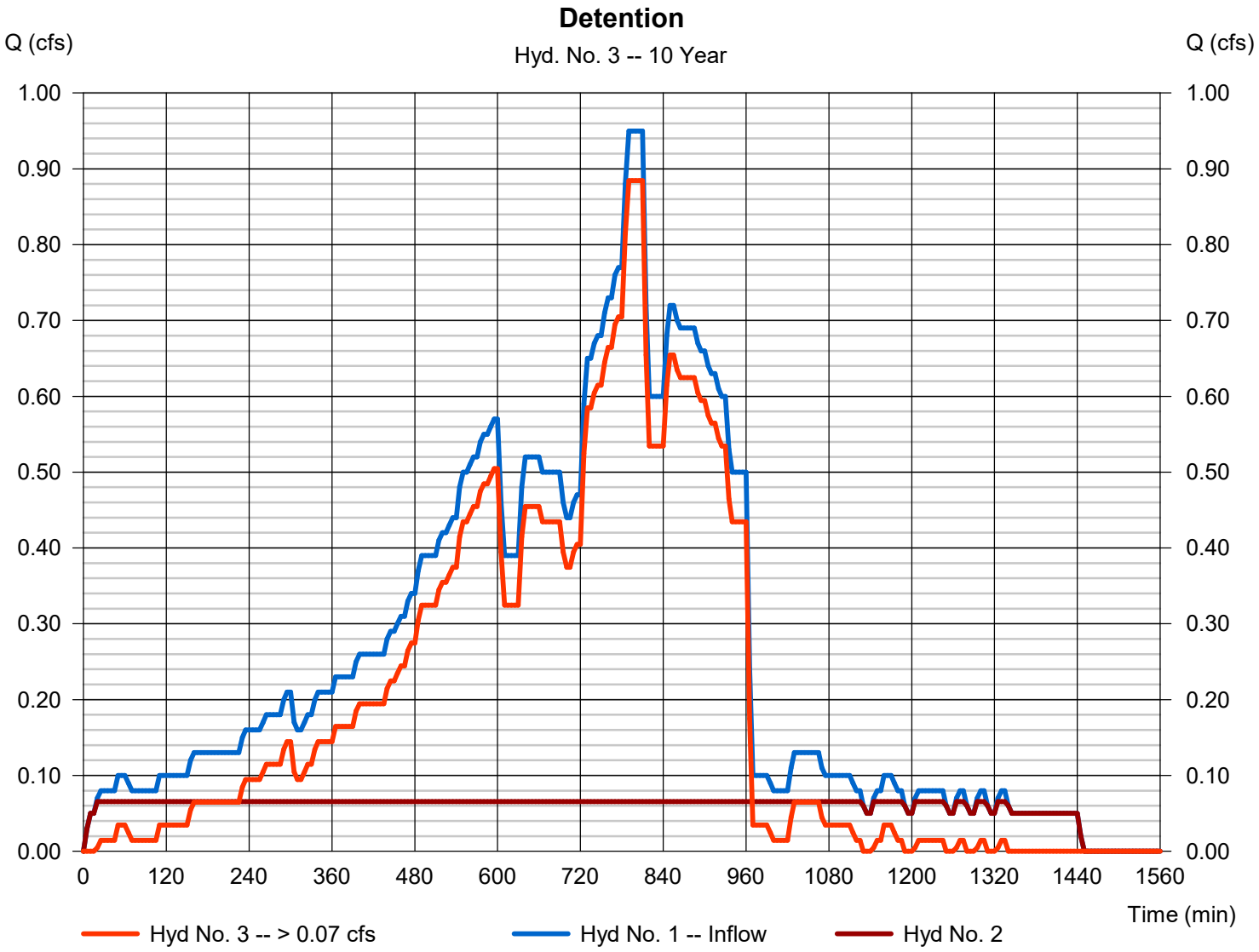


Hydrograph Report

Hyd. No. 3

Detention

Hydrograph type	= Diversion2	Peak discharge	= 0.885 cfs
Storm frequency	= 10 yrs	Time to peak	= 790 min
Time interval	= 5 min	Hyd. volume	= 18,122 cuft
Inflow hydrograph	= 1 - inflow hydrograph	2nd diverted hyd.	= 2
Diversion method	= Constant Q	Constant Q	= 0.07 cfs



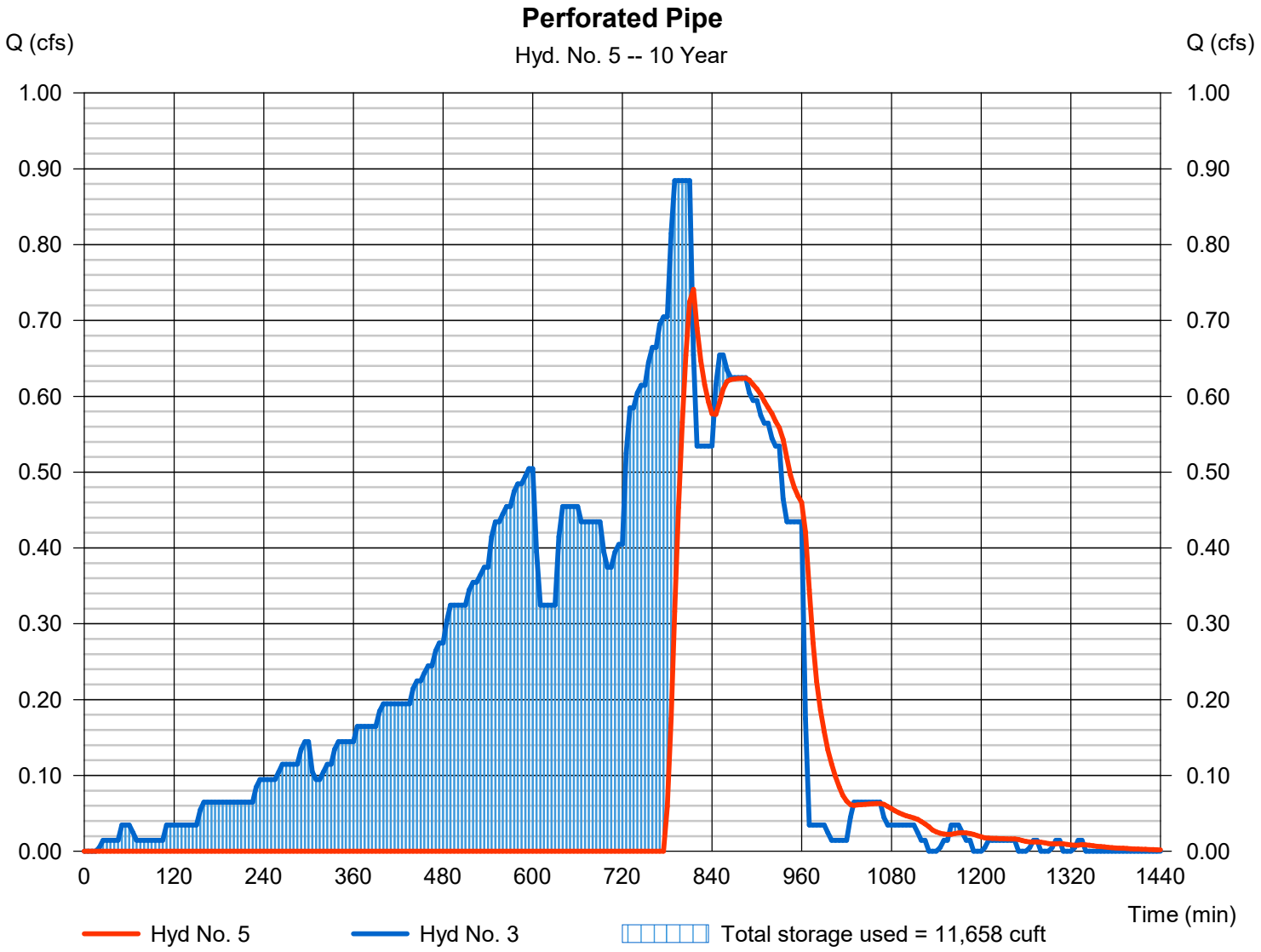
Hydrograph Report

Hyd. No. 5

Perforated Pipe

Hydrograph type	=	Reservoir	Peak discharge	=	0.741 cfs
Storm frequency	=	10 yrs	Time to peak	=	815 min
Time interval	=	5 min	Hyd. volume	=	7,423 cuft
Inflow hyd. No.	=	3 - Detention	Max. Elevation	=	103.13 ft
Reservoir name	=	Infiltration Basin	Max. Storage	=	11,658 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

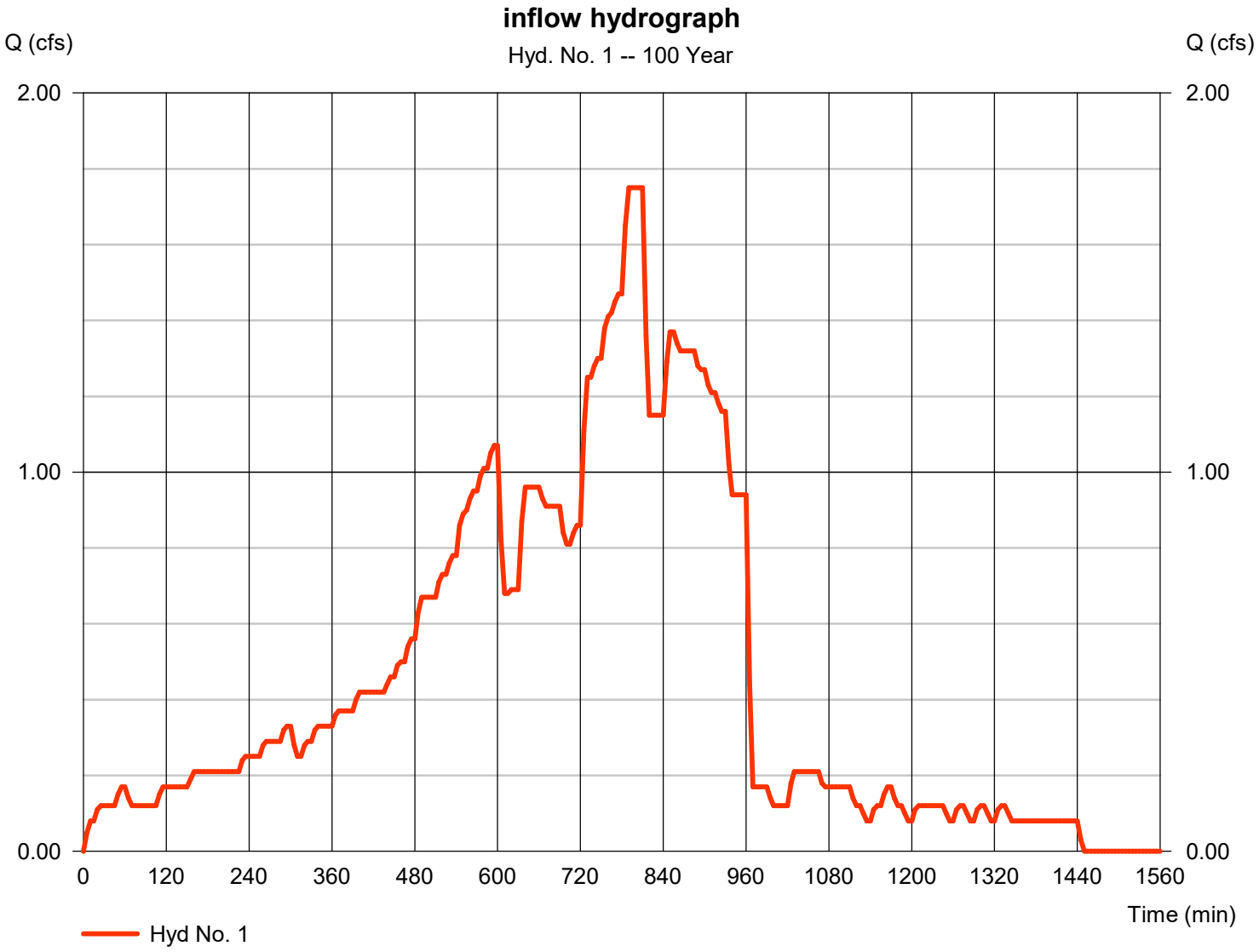
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Manual	1.750	5	790	42,135	------	------	------	inflow hydrograph
2	Diversion1	0.065	5	160	5,654	1	------	------	Infiltration
3	Diversion2	1.685	5	790	36,481	1	------	------	Detention
5	Reservoir	1.592	5	810	25,782	3	103.51	12,417	Perforated Pipe

Hydrograph Report

Hyd. No. 1

inflow hydrograph

Hydrograph type	= Manual	Peak discharge	= 1.750 cfs
Storm frequency	= 100 yrs	Time to peak	= 790 min
Time interval	= 5 min	Hyd. volume	= 42,135 cuft

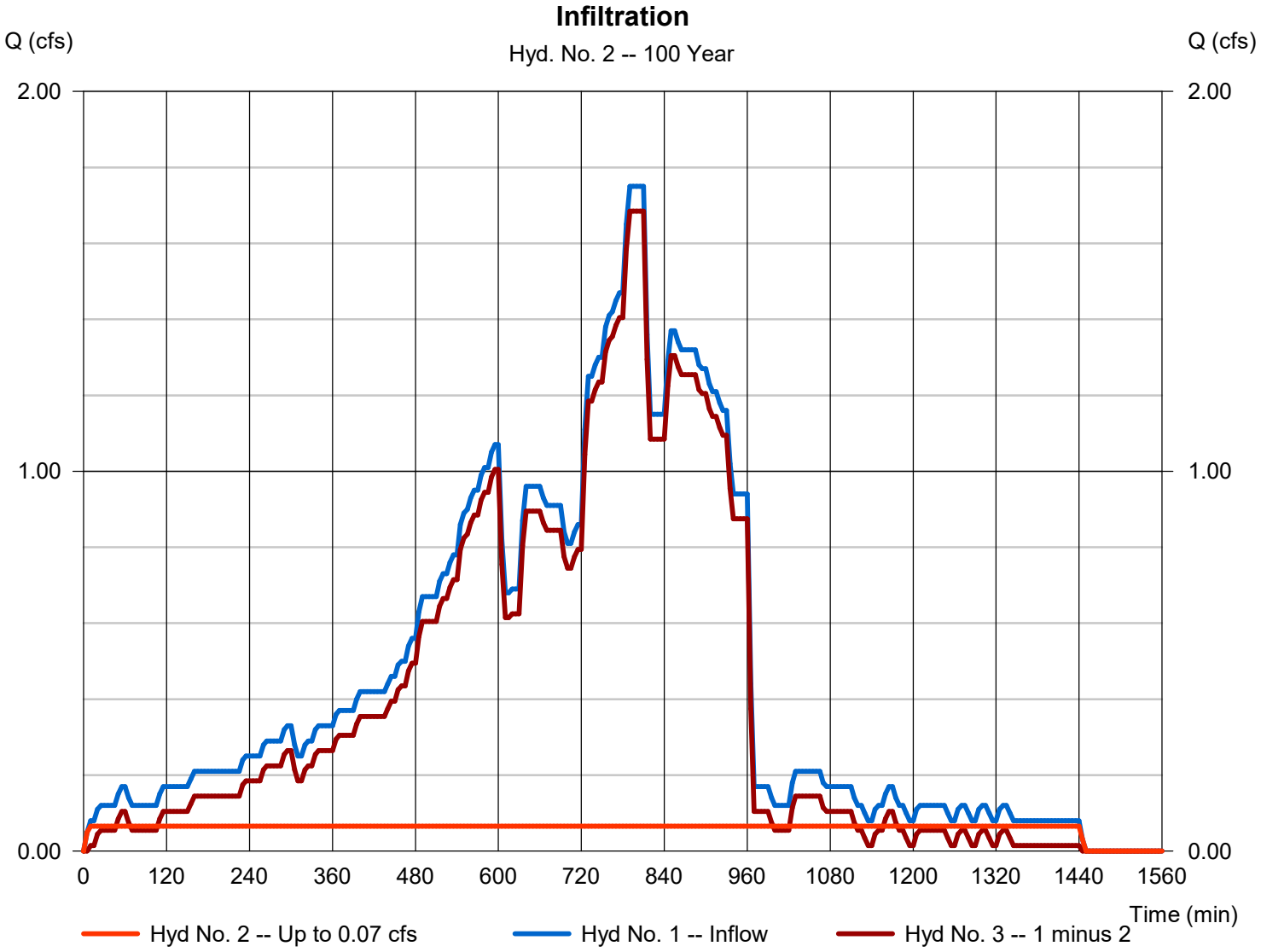


Hydrograph Report

Hyd. No. 2

Infiltration

Hydrograph type	= Diversion1	Peak discharge	= 0.065 cfs
Storm frequency	= 100 yrs	Time to peak	= 160 min
Time interval	= 5 min	Hyd. volume	= 5,654 cuft
Inflow hydrograph	= 1 - inflow hydrograph	2nd diverted hyd.	= 3
Diversion method	= Constant Q	Constant Q	= 0.07 cfs

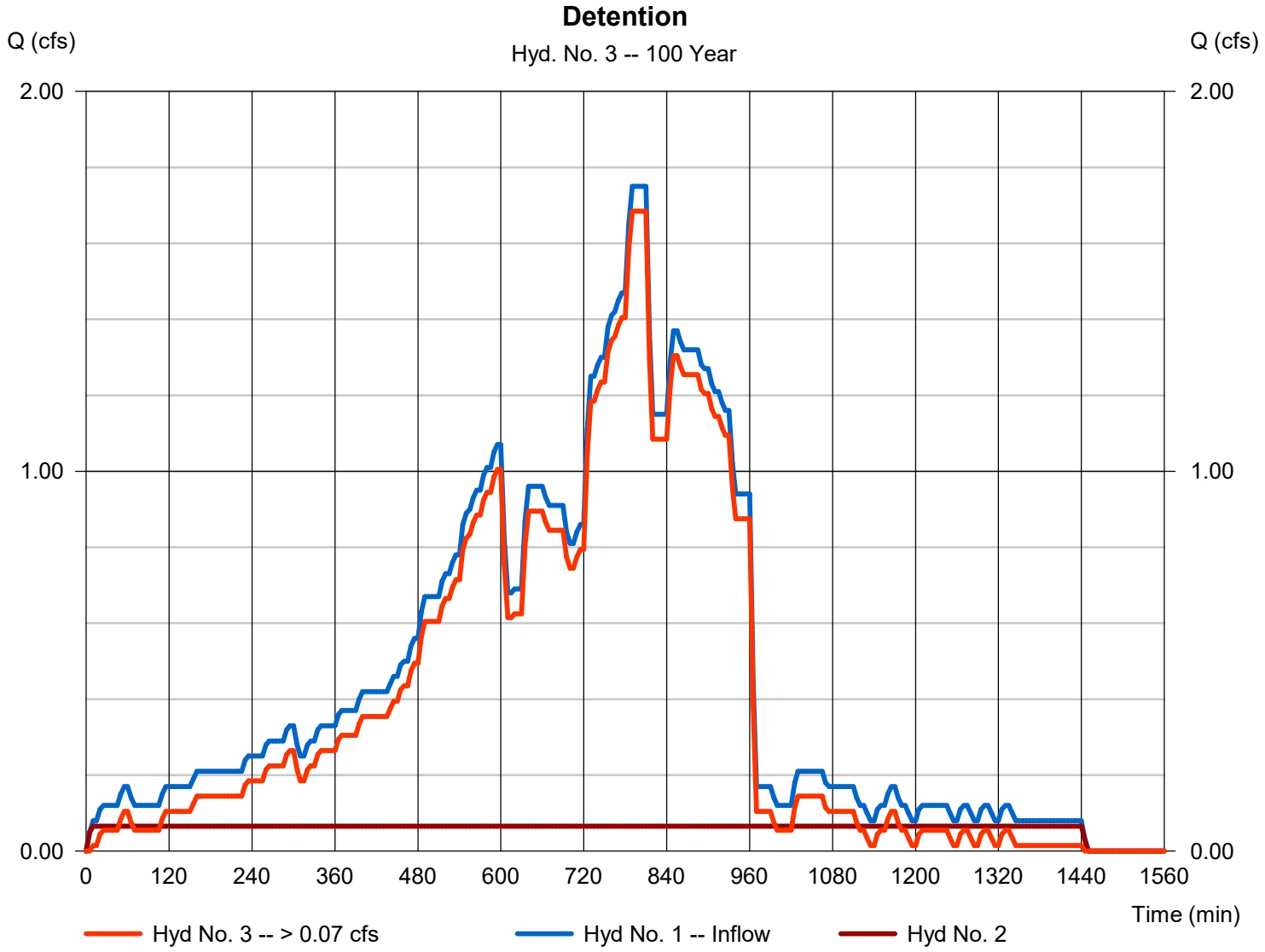


Hydrograph Report

Hyd. No. 3

Detention

Hydrograph type	= Diversion2	Peak discharge	= 1.685 cfs
Storm frequency	= 100 yrs	Time to peak	= 790 min
Time interval	= 5 min	Hyd. volume	= 36,481 cuft
Inflow hydrograph	= 1 - inflow hydrograph	2nd diverted hyd.	= 2
Diversion method	= Constant Q	Constant Q	= 0.07 cfs



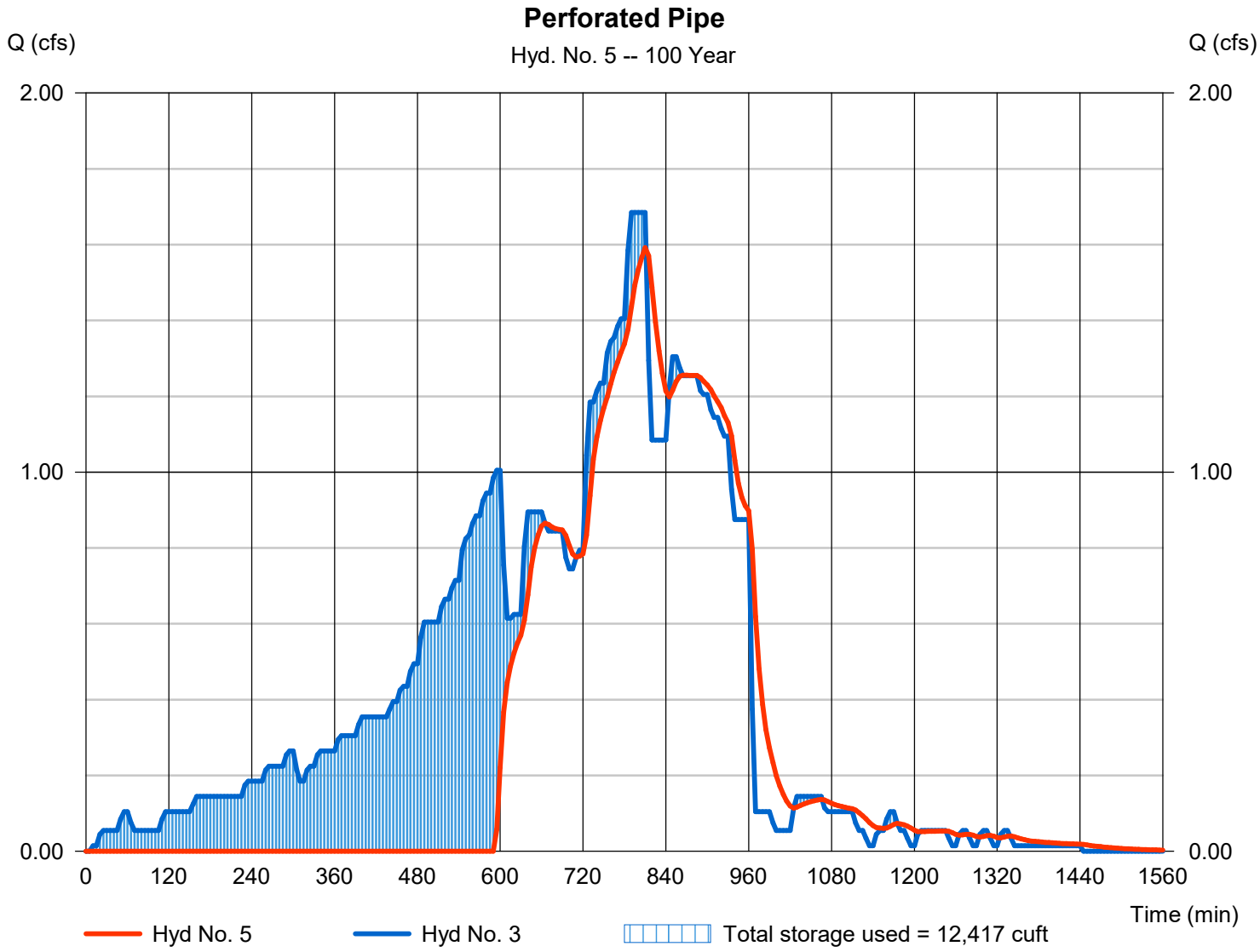
Hydrograph Report

Hyd. No. 5

Perforated Pipe

Hydrograph type	=	Reservoir	Peak discharge	=	1.592 cfs
Storm frequency	=	100 yrs	Time to peak	=	810 min
Time interval	=	5 min	Hyd. volume	=	25,782 cuft
Inflow hyd. No.	=	3 - Detention	Max. Elevation	=	103.51 ft
Reservoir name	=	Infiltration Basin	Max. Storage	=	12,417 cuft

Storage Indication method used.



Appendix 8: Source Control

Pollutant Sources/Source Control Checklist

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

1 **Potential Sources of Runoff Pollutants**	2 **Permanent Controls**— Shown on **WQMP Drawings**	3 **Permanent Controls**– Listed in WQMP **Table and Narrative**	4 **Operational BMPs**— Included in WQMP **Table and Narrative**
☑ **A.** On-site storm drain inlets	☑ Locations of inlets.	☑ Mark all inlets with the words "Only Rain Down the Storm Drain" or similar. Catch Basin Markers may be available from the Riverside County Flood Control and Water Conservation District, call 951.955.1200 to verify.	☑ Maintain and periodically repaint or replace inlet markings. ☑ Provide stormwater pollution prevention information to new site owners, lessees, or operators. ☑ See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com ☑ Include the following in lease agreements: "Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains."
☑ **B.** Interior floor drains and elevator shaft sump pumps		☑ State that interior floor drains and elevator shaft sump pumps will be plumbed to sanitary sewer.	☑ Inspect and maintain drains to prevent blockages and overflow.
☐ **C.** Interior parking garages		☐ State that parking garage floor drains will be plumbed to the sanitary sewer.	☐ Inspect and maintain drains to prevent blockages and overflow.

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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☐ **D1.** Need for future indoor & structural pest control		☐ Note building design features that discourage entry of pests.	☐ Provide Integrated Pest Management information to owners, lessees, and operators.
✓ **D2.** Landscape/ Outdoor Pesticide Use	✓ Show locations of native trees or areas of shrubs and ground cover to be undisturbed and retained. ✓ Show self-retaining landscape areas, if any. ✓ Show stormwater treatment and hydrograph modification management BMPs. (See instructions in Chapter 3, Step 5 and guidance in Chapter 5.)	State that final landscape plans will accomplish all of the following. ✓ Preserve existing native trees, shrubs, and ground cover to the maximum extent possible. ✓ Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution. ✓ Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions. ✓ Consider using pest-resistant plants, especially adjacent to hardscape. ✓ To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.	✓ Maintain landscaping using minimum or no pesticides. ✓ See applicable operational BMPs in "What you should know for…..Landscape and Gardening" at http://rcflood.org/stormwater/downloads/landscapegardenbrochure.pdf ✓ Provide IPM information to new owners, lessees and operators.

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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☐ **E.** Pools, spas, ponds, decorative fountains, and other water features.	☐ Show location of water feature and a sanitary sewer cleanout in an accessible area within 10 feet. (Exception: Public pools must be plumbed according to County Department of Environmental Health Guidelines.)	If the Co-Permittee requires pools to be plumbed to the sanitary sewer, place a note on the plans and state in the narrative that this connection will be made according to local requirements.	☐ See applicable operational BMPs in "Guidelines for Maintaining Your Swimming Pool, Jacuzzi and Garden Fountain" at http://rcflood.org/stormwater/
☐ **F.** Food service	☐ For restaurants, grocery stores, and other food service operations, show location (indoors or in a covered area outdoors) of a floor sink or other area for cleaning floor mats, containers, and equipment. ☐ On the drawing, show a note that this drain will be connected to a grease interceptor before discharging to the sanitary sewer.	☐ Describe the location and features of the designated cleaning area. ☐ Describe the items to be cleaned in this facility and how it has been sized to insure that the largest items can be accommodated.	☐ See the brochure, "The Food Service Industry Best Management Practices for: Restaurants, Grocery Stores, Delicatessens and Bakeries" at http://rcflood.org/stormwater/ Provide this brochure to new site owners, lessees, and operators.
☑ **G.** Refuse areas	☑ Show where site refuse and recycled materials will be handled and stored for pickup. See local municipal requirements for sizes and other details of refuse areas. ☑ If dumpsters or other receptacles are outdoors, show how the designated area will be covered, graded, and paved to prevent run-on and show locations of berms to prevent runoff from the area. ☐ Any drains from dumpsters, compactors, and tallow bin areas shall be connected to a grease removal device before discharge to sanitary sewer.	☑ State how site refuse will be handled and provide supporting detail to what is shown on plans. ☑ State that signs will be posted on or near dumpsters with the words "Do not dump hazardous materials here" or similar.	☑ State how the following will be implemented: Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Keep receptacles covered. Prohibit/prevent dumping of liquid or hazardous wastes. Post "no hazardous materials" signs. Inspect and pick up litter daily and clean up spills immediately. Keep spill control materials available on-site. See Fact Sheet SC-34, "Waste Handling and Disposal" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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❑ **H.** Industrial processes.	❑ Show process area. All processing areas are indoor.	❑ If industrial processes are to be located on site, state: "All process activities to be performed indoors. No processes to drain to exterior or to storm drain system."	❑ See Fact Sheet SC-10, "Non-Stormwater Discharges" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com See the brochure "Industrial & Commercial Facilities Best Management Practices for: Industrial, Commercial Facilities" at http://rcflood.org/stormwater/

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

1 **Potential Sources of Runoff Pollutants**	2 **Permanent Controls**— Shown on **WQMP Drawings**	3 **Permanent Controls**– Listed in WQMP **Table and Narrative**	4 **Operational BMPs**— Included in WQMP **Table and Narrative**
❑ **I.** Outdoor storage of equipment or materials. (See rows J and K for source control measures for vehicle cleaning, repair, and maintenance.)	❑ Show any outdoor storage areas, including how materials will be covered. Show how areas will be graded and bermed to prevent run-on or run-off from area. ❑ Storage of non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system, and be contained by berms, dikes, liners, or vaults. ❑ Storage of hazardous materials and wastes must be in compliance with the local hazardous materials ordinance and a Hazardous Materials Management Plan for the site.	Include a detailed description of materials to be stored, storage areas, and structural features to prevent pollutants from entering storm drains. Where appropriate, reference documentation of compliance with the requirements of Hazardous Materials Programs for: ▪ Hazardous Waste Generation ▪ Hazardous Materials Release Response and Inventory ▪ California Accidental Release (CalARP) ▪ Aboveground Storage Tank ▪ Uniform Fire Code Article 80 Section 103(b) & (c) 1991 ▪ Underground Storage Tank www.cchealth.org/groups.hazmat/	❑ See the Fact Sheets SC-31, "Outdoor Liquid Container Storage" and SC-33, "Outdoor Storage of Raw Materials " in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

1 **Potential Sources of Runoff Pollutants**	2 **Permanent Controls**— Shown on **WQMP Drawings**	3 **Permanent Controls**– Listed in WQMP **Table and Narrative**	4 **Operational BMPs**— Included in WQMP **Table and Narrative**
❑ **J.** Vehicle and Equipment Cleaning	❑ Show on drawings as appropriate: (1) Commercial/industrial facilities having vehicle/equipment cleaning needs shall either provide a covered, bermed area for washing activities or discourage vehicle/equipment washing by removing hose bibs and installing signs prohibiting such uses. (2) Multi-dwelling complexes shall have a paved, bermed, and covered car wash area (unless car washing is prohibited on-site and hoses are provided with an automatic shut-off to discourage such use). (3) Washing areas for cars, vehicles, and equipment shall be paved, designed to prevent run-on to or runoff from the area, and plumbed to drain to the sanitary sewer. (4) Commercial car wash facilities shall be designed such that no runoff from the facility is discharged to the storm drain system. Wastewater from the facility shall discharge to the sanitary sewer, or a wastewater reclamation system shall be installed.	❑ If a car wash area is not provided, describe any measures taken to discourage on-site car washing and explain how these will be enforced.	Describe operational measures to implement the following (if applicable): ❑ Washwater from vehicle and equipment washing operations shall not be discharged to the storm drain system. Refer to "Outdoor Cleaning Activities and Professional Mobile Service Providers" for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at http://rcflood.org/stormwater/ ❑Car dealerships and similar may rinse cars with water only.

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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❑ **K.** Vehicle/Equipment Repair and Maintenance	❑ Accommodate all vehicle equipment repair and maintenance indoors. Or designate an outdoor work area and design the area to prevent run-on and runoff of stormwater. ❑ Show secondary containment for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas. ❑ Add a note on the plans that states either (1) there are no floor drains, or (2) floor drains are connected to wastewater pretreatment systems prior to discharge to the sanitary sewer and an industrial waste discharge permit will be obtained.	❑ State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area. ❑ State that there are no floor drains or if there are floor drains, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements. ❑ State that there are no tanks, containers or sinks to be used for parts cleaning or rinsing or, if there are, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.	In the Stormwater Control Plan, note that all of the following restrictions apply to use the site: ❑ No person shall dispose of, nor permit the disposal, directly or indirectly of vehicle fluids, hazardous materials, or rinsewater from parts cleaning into storm drains. ❑ No vehicle fluid removal shall be performed outside a building, nor on asphalt or ground surfaces, whether inside or outside a building, except in such a manner as to ensure that any spilled fluid will be in an area of secondary containment. Leaking vehicle fluids shall be contained or drained from the vehicle immediately. ❑ No person shall leave unattended drip parts or other open containers containing vehicle fluid, unless such containers are in use or in an area of secondary containment. Refer to "Automotive Maintenance & Car Care Best Management Practices for Auto Body Shops, Auto Repair Shops, Car Dealerships, Gas Stations and Fleet Service Operations". Brochure can be found at http://rcflood.org/stormwater/ Refer to Outdoor Cleaning Activities and Professional Mobile Service Providers for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at http://rcflood.org/stormwater/

1 **Potential Sources of Runoff Pollutants**	2 **Permanent Controls**— Shown on **WQMP Drawings**	3 **Permanent Controls**– Listed in WQMP **Table and Narrative**	4 **Operational BMPs**— Included in WQMP **Table and Narrative**
❑ **L.** Fuel Dispensing Areas	❑ Fueling areas[6] shall have impermeable floors (i.e., portland cement concrete or equivalent smooth impervious surface) that are: a) graded at the minimum slope necessary to prevent ponding; and b) separated from the rest of the site by a grade break that prevents run-on of stormwater to the maximum extent practicable. ❑ Fueling areas shall be covered by a canopy that extends a minimum of ten feet in each direction from each pump. [Alternative: The fueling area must be covered and the cover's minimum dimensions must be equal to or greater than the area within the grade break or fuel dispensing area[1].] The canopy [or cover] shall not drain onto the fueling area.		❑ The property owner shall dry sweep the fueling area routinely. ❑ See the Fact Sheet SD-30 , "Fueling Areas" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

[6] The fueling area shall be defined as the area extending a minimum of 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly may be operated plus a minimum of one foot, whichever is greater.

1 **Potential Sources of Runoff Pollutants**	2 **Permanent Controls**— Shown on **WQMP Drawings**	3 **Permanent Controls**– Listed in WQMP **Table and Narrative**	4 **Operational BMPs**— Included in WQMP **Table and Narrative**
❑ **M.** Loading Docks	❑ Show a preliminary design for the loading dock area, including roofing and drainage. Loading docks shall be covered and/or graded to minimize run-on to and runoff from the loading area. Roof downspouts shall be positioned to direct stormwater away from the loading area. Water from loading dock areas shall be drained to the sanitary sewer, or diverted and collected for ultimate discharge to the sanitary sewer. ❑ Loading dock areas draining directly to the sanitary sewer shall be equipped with a spill control valve or equivalent device, which shall be kept closed during periods of operation. ❑ Provide a roof overhang over the loading area or install door skirts (cowling) at each bay that enclose the end of the trailer.		❑ Move loaded and unloaded items indoors as soon as possible. ❑ See Fact Sheet SC-30, "Outdoor Loading and Unloading," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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✓ **N.** Fire Sprinkler Test Water		✓ Provide a means to drain fire sprinkler test water to the sanitary sewer.	✓ See the note in Fact Sheet SC-41, "Building and Grounds Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com
O. Miscellaneous Drain or Wash Water or Other Sources ☐ Boiler drain lines ✓ Condensate drain lines ✓ Rooftop equipment ☐ Drainage sumps ✓ Roofing, gutters, and trim. ☐ Other sources		☐ Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system. ✓ Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur. Condensate drain lines may not discharge to the storm drain system. ✓ Rooftop equipment with potential to produce pollutants shall be roofed and/or have secondary containment. ☐ Any drainage sumps on-site shall feature a sediment sump to reduce the quantity of sediment in pumped water. ✓ Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff. ☐ Include controls for other sources as specified by local reviewer.	

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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☑ **P.** Plazas, sidewalks, and parking lots.			☑ Sweep plazas, sidewalks, and parking lots regularly to prevent accumulation of litter and debris. Collect debris from pressure washing to prevent entry into the storm drain system. Collect washwater containing any cleaning agent or degreaser and discharge to the sanitary sewer not to a storm drain.

Appendix 9: O&M

Operation and Maintenance Plan

BMP Type	Inspection/Maintenance Required	Minimum Frequency of Activities
Irrigation	Inspect irrigation equipment. Check water sensors and adjust irrigation heads and timing.	Monthly or according to established maintenance schedule
Landscape Areas	Landscape maintenance will consist of trimming and replanting of vegetation, repair and maintenance of irrigation systems, and appropriate use of fertilizers and pesticides.	Monthly or according to established maintenance schedule
Storm Drain (Detention System)	Inspect for structural issues, leaks, damage, trash and debris.	Quarterly and after storm events
Trash Enclosure	Pick up trash on ground and place in receptacles. Close any lids that are left open. Make repairs to structural elements as necessary. Remove accumulations of trash.	Daily to inspect trash lids and dumpster areas. Monthly to inspect structural elements.

FloGard +Plus® Catch Basin Insert Filter

Inlet Filtration

Removes pollutants from runoff at the source

FloGard +Plus is a catch basin insert filter designed to remove suspended sediment, trash, and petroleum hydrocarbons from stormwater runoff. FloGard +Plus is ideally suited for removal of primary pollutants from paved surfaces in commercial and residential areas. Rated filter flow capacities are designed to exceed the required "first flush" treatment flow rate, and the unique dual-bypass design typically exceeds catch basin inlet capacity.

Economical Treatment
Quick, easy and cost-effective to install, inspect, and maintain.

Efficient Performance
Removes pollutants at the inlet where they are easiest to catch.

Versatile Applications
Appropriate and easy to use on new construction or retrofit projects.

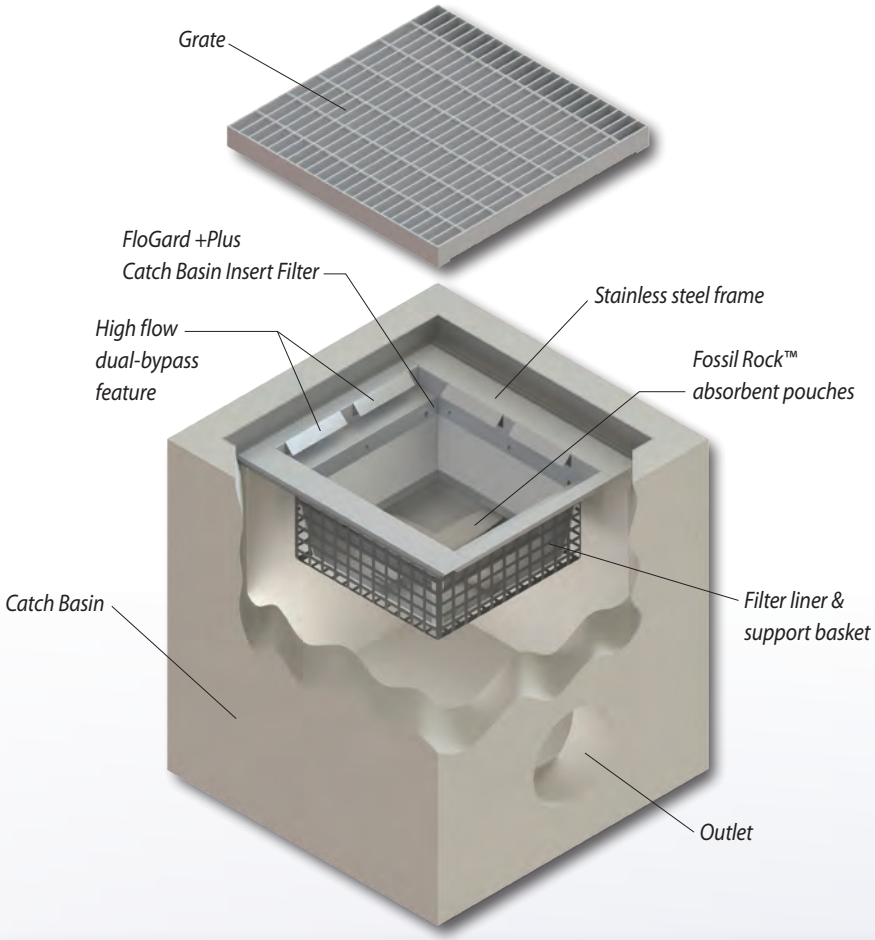
Flexible Design
Available in a wide variety of sizes and configurations, including custom options.

Durable Construction
Built to last and withstand the loads from captured pollutants.

Environmentally Friendly
No standing water minimizes vector, bacteria, and odor problems.

Proven Performance
Field and laboratory tested with up to 86%[1] removal of TSS and 80%[2] removal of oils and grease.

1. *University of Auckland laboratory testing of local street sweep material.*
2. *UCLA laboratory study.*



How It Works:
Flows entering the unit pass through the filter liner basket for removal of sediment, trash, and debris. Optional Fossil Rock™ absorbent pouches installed in the basket effect hydrocarbon capture. As the storm flow exceeds the treatment flow rate, treatment will continue and excess flows will pass through the dual-bypass openings near the top of the unit.

FloGard +Plus Catch Basin Insert Filter

Catch basin insert designed to capture sediment, trash and petroleum hydrocarbons from low (first flush) flows, even during the most extreme weather conditions.

Example Types, Sizes and Capacities

Additional sizes, including regional and custom options are available.

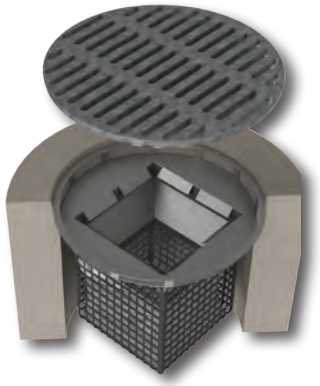
FloGard Combination Inlet SPECIFIER CHART								
MODEL NO. STANDARD DEPTH	STANDARD & SHALLOW DEPTH (Data in these columes is the same for both STANDARD & SHALLOW versions)			STANDARD DEPTH -20 Inches-		MODEL NO. SHALLOW DEPTH	SHALLOW DEPTH -12 Inches-	
	INLET ID Inside Dimension (inch x inch)	GRATE OD Outside Dimension (inch x inch)	TOTAL BYPASS CAPACITY (cu. ft. / sec.)	SOLIDS STORAGE CAPACITY (cu. ft.)	FILTERED FLOW (cu. ft. / sec.)		SOLIDS STORAGE CAPACITY (cu. ft.)	FILTERED FLOW (cu. ft. / sec.)
FGP-1633FGO	16 X 33	18 X 36	7.0	2.5	1.7	FGP-1633FGO8	1.4	1.1
FGP-1836FGO	18 X 36	18 X 40	6.9	2.3	1.6	FGP-1836FGO8	1.3	.9
FGP-2234FGO	22 X 34	24 X 36	8.1	3.6	2.1	FGP-2234FGO8	2.1	1.4
FGP-2436FGO	24 X 36	24 X 40	8.0	3.4	2.0	FGP-2436FGO8	1.95	1.15

Combination Inlet

FloGard Flat Grated Inlet SPECIFIER CHART								
MODEL NO. STANDARD DEPTH	STANDARD & SHALLOW DEPTH (Data in these columes is the same for both STANDARD & SHALLOW versions)			STANDARD DEPTH -20 Inches-		MODEL NO. SHALLOW DEPTH	SHALLOW DEPTH -12 Inches-	
	INLET ID Inside Dimension (inch x inch)	GRATE OD Outside Dimension (inch x inch)	TOTAL BYPASS CAPACITY (cu. ft. / sec.)	SOLIDS STORAGE CAPACITY (cu. ft.)	FILTERED FLOW (cu. ft. / sec.)		SOLIDS STORAGE CAPACITY (cu. ft.)	FILTERED FLOW (cu. ft. / sec.)
FGP-12F	12 X 12	12 X 14	2.8	0.3	0.4	FGP-12F8	.15	.25
FGP-16F	16 X 16	16 X 19	4.7	0.8	0.7	FGP-16F8	.45	.4
FGP-18F	18 X 18	18 X 20	4.7	0.8	0.7	FGP-18F8	.45	.4
FGP-1836F	18 X 36	18 X 40	6.9	2.3	1.6	FGP-1836F8	1.3	.9
FGP-21F	22 X 22	22 X 24	6.1	2.2	1.5	FGP-21F8	1.25	.85
FGP-24F	24 X 24	24 X 27	6.1	2.2	1.5	FGP-24F8	1.25	.85
FGP-2436F	24 X 36	24 X 40	8.0	3.4	2.0	FGP-2436F8	1.95	1.15
FGP-2448F	24 X 48	24 X 48	9.3	4.4	2.4	FGP-2448F8	2.5	1.35
FGP-32F-TN	28 X 28	32 X 32	6.3	2.2	1.5	FGP-32F8-TN	1.25	.85
FGP-30F	30 X 30	30 X 34	8.1	3.6	2.0	FGP-30F8	2.05	1.15
FGP-36F	36 X 36	36 X 40	9.1	4.6	2.4	FGP-36F8	2.65	1.35
FGP-3648F	36 X 48	40 X 48	11.5	6.8	3.2	FGP-3648F8	3.9	1.85
FGP-48F	48 X 48	48 X 54	13.2	9.5	3.9	FGP-48F8	5.45	2.25
FGP-1633F	16 X 34	18 X 36	6.9	2.3	1.6	FGP-1633F8	1.3	.9
FGP-2234F	22 X 34	24 X 36	8.0	3.4	2.0	FGP-2234F8	1.95	1.15

Flat Grated Inlet

FloGard Circular Grated Inlet SPECIFIER CHART					
MODEL NUMBER	INLET ID (Ø INCHES)	GRATE OD (Ø INCHES)	SOLIDS STORAGE CAPACITY (CU FT)	FILTERED FLOW (CFS)	TOTAL BYPASS CAPACITY (CFS)
FGP-RF15F	16	18	0.3	0.4	2.8
FGP-RF18F	18	20	0.8	0.7	4.7
FGP-RF20F	21	23	0.8	0.7	4.7
FGP-RF21F	22	23.5	0.8	0.7	4.7
FGP-RF22F	23	24	0.8	0.7	4.7
FGP-RF24F	24	26	0.8	0.7	4.7
FGP-RF30F	30	32	2.2	1.5	6.1
FGP-RF36F	36	39	3.6	2.0	8.1



Circular Frame Catch Basin

Visit our website: oldcastlestormwater.com or call (800) 579-8819 for additional sizes and options.

Appendix 10: Educational Materials

Stormwater Pollution Prevention & Spill Response Plan template

BMP Fact Sheets, Maintenance Guidelines and Other End-User BMP Information

Trained Contractor and Personnel Log

Stormwater Management Training Log and Documentation

Project Name: _

WDID #: _____

Stormwater Management Topic: (check as appropriate)

☐ Erosion Control ☐ Sediment Control

☐ Wind Erosion Control ☐ Tracking Control

☐ Non-Stormwater Management ☐ Waste Management and Materials Pollution Control

☐ Stormwater Sampling ☐ Other (explain)

Specific Training Objective: ____

Location: _____ Date: __

Instructor:_____ Telephone: ____

Course Length (hours):

Attendee Roster (Attach additional forms if necessary)

Name	Company	Phone

As needed, add proof of external training (e.g., course completion certificates, credentials for QSP, QSD).

After the Storm

A Citizen's Guide to Understanding Stormwater

WHEN IT RAINS IT DRAINS

For more information contact:

or visit
www.epa.gov/npdes/stormwater
www.epa.gov/nps

EPA United States Environmental Protection Agency

EPA 833-B-03-002

January 2003

THE YEAR OF CLEAN WATER

Internet Address (URL) • HTTP://www.epa.gov
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What is stormwater runoff?

Stormwater runoff occurs when precipitation from rain or snowmelt flows over the ground. Impervious surfaces like driveways, sidewalks, and streets prevent stormwater from naturally soaking into the ground.

Why is stormwater runoff a problem?

Stormwater can pick up debris, chemicals, dirt, and other pollutants and flow into a storm sewer system or directly to a lake, stream, river, wetland, or coastal water. Anything that enters a storm sewer system is discharged untreated into the waterbodies we use for swimming, fishing, and providing drinking water.

The effects of pollution

Polluted stormwater runoff can have many adverse effects on plants, fish, animals, and people.

- Sediment can cloud the water and make it difficult or impossible for aquatic plants to grow. Sediment also can destroy aquatic habitats.
- Excess nutrients can cause algae blooms. When algae die, they sink to the bottom and decompose in a process that removes oxygen from the water. Fish and other aquatic organisms can't exist in water with low dissolved oxygen levels.
- Bacteria and other pathogens can wash into swimming areas and create health hazards, often making beach closures necessary.

- Debris—plastic bags, six-pack rings, bottles, and cigarette butts—washed into waterbodies can choke, suffocate, or disable aquatic life like ducks, fish, turtles, and birds.
- Household hazardous wastes like insecticides, pesticides, paint, solvents, used motor oil, and other auto fluids can poison aquatic life. Land animals and people can become sick or die from eating diseased fish and shellfish or ingesting polluted water.
- Polluted stormwater often affects drinking water sources. This, in turn, can affect human health and increase drinking water treatment costs.

Stormwater Pollution Solutions

Education is essential to changing people's behavior. Signs and markers near storm drains warn residents that pollutants entering the drains will be carried untreated into a local waterbody.

Residential

Recycle or properly dispose of household products that contain chemicals, such as insecticides, pesticides, paint, solvents, and used motor oil and other auto fluids. Don't pour them onto the ground or into storm drains.

Lawn care

Excess fertilizers and pesticides applied to lawns and gardens wash off and pollute streams. In addition, yard clippings and leaves can wash into storm drains and contribute nutrients and organic matter to streams.

- Don't overwater your lawn. Consider using a soaker hose instead of a sprinkler.
- Use pesticides and fertilizers sparingly. When use is necessary, use these chemicals in the recommended amounts. Use organic mulch or safer pest control methods whenever possible.
- Compost or mulch yard waste. Don't leave it in the street or sweep it into storm drains or streams.
- Cover piles of dirt or mulch being used in landscaping projects.

Auto care

Washing your car and degreasing auto parts at home can send detergents and other contaminants through the storm sewer system. Dumping automotive fluids into storm drains has the same result as dumping the materials directly into a waterbody.

- Use a commercial car wash that treats or recycles its wastewater, or wash your car on your yard so the water infiltrates into the ground.
- Repair leaks and dispose of used auto fluids and batteries at designated drop-off or recycling locations.

Septic systems

Leaking and poorly maintained septic systems release nutrients and pathogens (bacteria and viruses) that can be picked up by stormwater and discharged into nearby waterbodies. Pathogens can cause public health problems and environmental concerns.

- Inspect your system every 3 years and pump your tank as necessary (every 3 to 5 years).
- Don't dispose of household hazardous waste in sinks or toilets.

Pet waste

Pet waste can be a major source of bacteria and excess nutrients in local waters.

- When walking your pet, remember to pick up the waste and dispose of it properly. Flushing pet waste is the best disposal method. Leaving pet waste on the ground increases public health risks by allowing harmful bacteria and nutrients to wash into the storm drain and eventually into local waterbodies.

Residential landscaping

Permeable Pavement—Traditional concrete and asphalt don't allow water to soak into the ground. Instead these surfaces rely on storm drains to divert unwanted water. Permeable pavement systems allow rain and snowmelt to soak through, decreasing stormwater runoff.

Rain Barrels—You can collect rainwater from rooftops in mosquito-proof containers. The water can be used later on lawn or garden areas.

Rain Gardens and Grassy Swales—Specially designed areas planted with native plants can provide natural places for rainwater to collect and soak into the ground. Rain from rooftop areas or paved areas can be diverted into these areas rather than into storm drains.

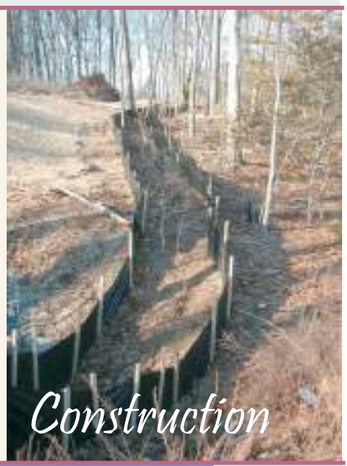
Vegetated Filter Strips—Filter strips are areas of native grass or plants created along roadways or streams. They trap the pollutants stormwater picks up as it flows across driveways and streets.

Commercial

Dirt, oil, and debris that collect in parking lots and paved areas can be washed into the storm sewer system and eventually enter local waterbodies.

- Sweep up litter and debris from sidewalks, driveways and parking lots, especially around storm drains.
- Cover grease storage and dumpsters and keep them clean to avoid leaks.
- Report any chemical spill to the local hazardous waste cleanup team. They'll know the best way to keep spills from harming the environment.

Construction



Erosion controls that aren't maintained can cause excessive amounts of sediment and debris to be carried into the stormwater system. Construction vehicles can leak fuel, oil, and other harmful fluids that can be picked up by stormwater and deposited into local waterbodies.

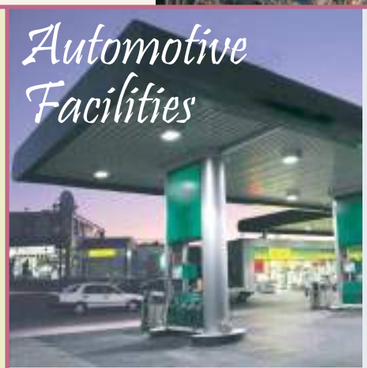
- Divert stormwater away from disturbed or exposed areas of the construction site.
- Install silt fences, vehicle mud removal areas, vegetative cover, and other sediment and erosion controls and properly maintain them, especially after rainstorms.
- Prevent soil erosion by minimizing disturbed areas during construction projects, and seed and mulch bare areas as soon as possible.

Agriculture

Lack of vegetation on streambanks can lead to erosion. Overgrazed pastures can also contribute excessive amounts of sediment to local waterbodies. Excess fertilizers and pesticides can poison aquatic animals and lead to destructive algae blooms. Livestock in streams can contaminate waterways with bacteria, making them unsafe for human contact.

- Keep livestock away from streambanks and provide them a water source away from waterbodies.
- Store and apply manure away from waterbodies and in accordance with a nutrient management plan.
- Vegetate riparian areas along waterways.
- Rotate animal grazing to prevent soil erosion in fields.
- Apply fertilizers and pesticides according to label instructions to save money and minimize pollution.

Automotive Facilities



Uncovered fueling stations allow spills to be washed into storm drains. Cars waiting to be repaired can leak fuel, oil, and other harmful fluids that can be picked up by stormwater.

- Clean up spills immediately and properly dispose of cleanup materials.
- Provide cover over fueling stations and design or retrofit facilities for spill containment.
- Properly maintain fleet vehicles to prevent oil, gas, and other discharges from being washed into local waterbodies.
- Install and maintain oil/water separators.

Forestry

Improperly managed logging operations can result in erosion and sedimentation.

- Conduct preharvest planning to prevent erosion and lower costs.
- Use logging methods and equipment that minimize soil disturbance.
- Plan and design skid trails, yard areas, and truck access roads to minimize stream crossings and avoid disturbing the forest floor.
- Construct stream crossings so that they minimize erosion and physical changes to streams.
- Expedite revegetation of cleared areas.

For Information:

For information on "closed-loop" suppliers and recycling/disposal vendors, contact:
County of Riverside
Health Services Agency
Department of Environmental Health
at (909) 358-5055.

SPILL RESPONSE AGENCY:
HAZ-MAT: (909) 358-5055
AFTER 5:00 P.M.: (909) 358-5245 OR 911

HAZARDOUS WASTE DISPOSAL: (909) 358-5055

RECYCLING INFORMATION: 1-800-366-SAVE

TO REPORT ILLEGAL DUMPING OR A CLOGGED STORM DRAIN: 1-800-506-2555

To order additional brochures or to obtain information on other pollution prevention activities, call: (909) 955-1111.

The Cities and County of Riverside
StormWater/CleanWater Protection Program
1-800-506-2555

StormWater CleanWater
PROTECTION PROGRAM

Riverside County gratefully acknowledges the Santa Clara Valley Nonpoint Source Pollution Control Program, Alameda Countywide Clean Water Program and the San Bernardino County Stormwater Program for information provided in this brochure.

StormWater Pollution

What you should know for...

THE FOOD SERVICE INDUSTRY

Best Management Practices (BMPS) for:

- Restaurants
- Grocery Stores
- Delicatessens
- Bakeries

StormWater Pollution . . . What You Should Know

Riverside County has two drainage systems - sanitary sewers and storm drains. The storm drain system is designed to help prevent flooding by carrying excess rainwater away from streets. Since the storm drain system does not provide for water treatment, it also serves the *unintended* function of transporting pollutants directly to our waterways.

Unlike sanitary sewers, storm drains are not connected to a treatment plant - they flow directly to our local streams, rivers and lakes.

Waste or washwater generated by the food service industry often contains materials such as food wastes, oil, grease, detergents, and degreasers. These materials can degrade local waters when allowed to flow into a storm drain system.

Stormwater pollution causes as much as 60% of our water pollution problem. It jeopardizes the quality of our waterways and poses a threat to groundwater resources if pollutants percolate through soil.

The Cities and County of Riverside StormWater/CleanWater Protection Program

Since preventing pollution is much easier, and less costly, than cleaning up "after the fact," the Cities and County of Riverside StormWater/CleanWater Protection Program informs residents and businesses on pollution prevention activities such as the Best Management Practices (BMPs) described in this pamphlet.

The Cities and County of Riverside have adopted ordinances for stormwater management and discharge control. In accordance with state and federal law, these local stormwater ordinances **prohibit** the discharge of wastes into the storm drain system or local surface waters. This includes discharges from the food service industry containing food wastes, oil, grease, detergents, and degreasers.

PLEASE NOTE: A common stormwater pollution problem associated with the food service industry is the discharge of washwater into alleys and gutters, and the hosing down of outdoor areas. Often, these activities flush pollutants into the storm drain system. The discharges of pollutants is ***strictly prohibited*** by local ordinances and state and federal regulations.

A Menu of Activities . . . to Keep Our Water Clean

Cleanin' It Right . . .

Pour mop and wash water into the mop sink or down floor drains . . . not into gutters, alleys, parking lots or a storm drain. Wash greasy equipment only in designated wash areas which are properly connected to the sewer system with an appropriate oil/water separator. Also, avoid washing kitchen mats, garbage containers, and other items in areas where wastewater is likely to flow into a storm drain.

Watch Out For Spills . . .

Use dry methods for spill cleanup. Don't hose down outside spills. Use rags or absorbents such as cat litter and then dispose of in the garbage, or handle as hazardous waste as appropriate. If necessary, mop the area with a minimum amount of water.

Proper Storage and Disposal . . .

General cleaners, floor cleaners, solvents, and detergents often contain toxic substances. Read labels carefully and store and dispose of these products properly.

REMEMBER: Don't throw toxic waste into the trash or into a storm drain. To report toxic spill call 911. For information on hazardous waste pick-up call (909) 358-5055.

Grease and Oil . . .

Handle and dispose of grease properly. Save used cooking grease and oil for recycling in tallow bins or sealed containers. Never pour grease into a sink, floor drain, dumpster or storm drain. Watch out for, and report to management, overflowing grease interceptors. Call (909) 358-5172 for disposal information.

How 'Bout That Dumpster . . .

Keep dumpster and loading dock areas clean. Control litter by sweeping - don't hose down the area. Replace leaky dumpsters and keep lids closed to keep out rainwater.

Use Water-Friendly Products . . .

Whenever possible, purchase water-based cleaning products. Look for products labeled "non-toxic," "non-petroleum based," "ammonia-free," "phosphate-free," and "perfume-free," or "readily biodegradable."

Outdoor/Sidewalk Areas . . .

Sweep up food particles, cigarette butts, and trash from outdoor dining areas before rinsing or steam cleaning. Don't use toxic bleaches or detergents when you pressure wash outdoor dining areas, entrances or surrounding sidewalk areas.

***You may be** already implementing many of the BMPs prescribed in this brochure. However, if you discover any potential problem areas, please consider using one or more of the recommended BMPS.*

***Also,** please note that the Riverside County Environmental Health Department will monitor potential sources of stormwater pollution activities during regularly scheduled inspections of food service facilities. If Health Department staff observe activities which may be contributing to stormwater pollution, suggestions will be provided and/or use of prescribed BMPS listed in this brochure will be offered.*

Please remember:

Everyone contributes a little to the problem of stormwater pollution. Now it's time for all of us to become part of the solution!

Riverside County Stormwater Program Members

City of Banning
(951) 922-3105

City of Beaumont
(951) 769-8520

City of Calimesa
(909) 795-9801

City of Canyon Lake
(951) 244-2955

City of Cathedral City
(760) 770-0340

City of Coachella
(760) 398-3502

City of Corona
(951) 736-2447

City of Desert Hot Springs
(760) 329-6411

City of Eastvale
(951) 361-0900

City of Hemet
(951) 765-2300

City of Indian Wells
(760) 346-2489

City of Indio
(760) 391-4000

City of Jurupa Valley
(951) 332-6464

City of Lake Elsinore
(951) 674-3124

City of La Quinta
(760) 777-7000

City of Menifee
(951) 672-6777

City of Moreno Valley
(951) 413-3000

City of Murrieta
(951) 304-2489

City of Norco
(951) 270-5607

City of Palm Desert
(760) 346-0611

City of Palm Springs
(760) 323-8299

City of Perris
(951) 943-6100

City of Rancho Mirage
(760) 324-4511

City of Riverside
(951) 826-5311

City of San Jacinto
(951) 487-7330

City of Temecula
(951) 694-6444

City of Wildomar
(951) 677-7751

Coachella Valley Water District
(760) 398-2651

County of Riverside
(951) 955-1000

Riverside County Flood Control District
(951) 955-1200

YOU can prevent Stormwater Pollution following these practices...

Industrial and Commercial Facilities

The Riverside County Stormwater Program has identified a number of Best Management Practices (BMPs) for Industrial and Commercial Facilities. These BMPs control and reduce stormwater pollutants from reaching our storm drain system and ultimately our local water bodies. City and County ordinances require businesses to use these BMPs to protect our water quality. Local cities and the County are required to verify implementation of these BMPs by performing regular facility inspections.

Prohibited Discharges

Discontinue all non-stormwater discharges to the storm drain system. It is *prohibited* to discharge any chemicals, paints, debris, wastes or wastewater into the gutter, street or storm drain.

Outdoor Storage BMPs

- Install covers and secondary containment areas for all hazardous materials and wastes stored outdoors in accordance with County and/or City standards.
- Keep all temporary waste containers covered, at all times when not in use.
- Sweep outdoor areas instead of using a hose or pressure washer.
- Move all process operations including vehicle/equipment maintenance inside of the building or under a covered and contained area.
- Wash equipment and vehicles in a contained and covered wash bay which is closed-loop or connected to a clarifier sized to local standards and discharged to a sanitary sewer or take them to a commercial car wash.

Spills and Clean Up BMPs

- Keep the work site clean and orderly. Remove debris in a timely fashion. Sweep up the area.
- Clean up spills immediately when they occur, using dry clean up methods such as absorbent materials or sweep followed by proper disposal of materials.
- Always have a spill kit available near chemical loading dock doors and vehicle maintenance and fueling areas.
- Follow your Business Emergency Plan, as filed with the local Fire Department.
- Report all prohibited discharges and non-implementation of BMPs to your local Stormwater Coordinator as listed on the back of this pamphlet.

- Report hazardous materials spills to 951-358-5055 or call after hours to 951-782-2973 or, if an emergency, call the Fire Department's Haz Mat Team at 911.

Plastic Manufacturing Facilities BMPs

AB 258 requires plastic product manufacturers to use BMPs, such as safe storage and clean-up procedures to prevent plastic pellets (nurdles) from entering the waterway. The plastic pellets are released into the environment during transporting, packaging and processing and migrate to waterways through the storm drain system. AB 258 will help protect fish and wildlife from the hazards of plastic pollution.

Training BMPs

As prescribed by your City and County Stormwater Ordinance(s), train employees in spill procedures and prohibit non-stormwater discharges to the storm drain system. Applicable BMP examples can be found at www.cabmphandbooks.com.

Permitting

Stormwater discharges associated with specific categories for industrial facilities are regulated by the State Water Resources Control Board through an Industrial Stormwater General Permit. A copy of this General Permit and application forms are available at: www.waterboards.ca.gov, select stormwater then the industrial quick link.

To report illegal dumping or for more information on stormwater pollution prevention call: 1-800-506-2555 or e-mail us at: fcnpdes@rcflood.org.

Landscaping and garden maintenance activities can be major contributors to water pollution. Soils, yard wastes, over-watering and garden chemicals become part of the urban runoff mix that winds its way through streets, gutters and storm drains before entering lakes, rivers, streams, etc. Urban runoff pollution contaminates water and harms aquatic life!

In Riverside County, report illegal discharges into the storm drain, call
1-800-506-2555
"Only Rain Down the Storm Drain"

Important Links:

Riverside County Household Hazardous Waste Collection Information
1-800-304-2226 or www.rivcowm.org

Riverside County Backyard Composting Program
1-800-366-SAVE

Integrated Pest Management (IPM) Solutions
www.ipm.ucdavis.edu

California Master Gardener Programs
www.mastergardeners.org
www.camastergardeners.ucdavis.edu

California Native Plant Society
www.cnps.org

The Riverside County "Only Rain Down the Storm Drain" Pollution Prevention Program gratefully acknowledges Orange County's Storm Water Program for their contribution to this brochure.

...Only Rain Down ...the Storm Drain

What you should know for... Landscape and Gardening

Best Management tips for:

- Professionals
- Novices
- Landscapers
- Gardeners
- Cultivators

Tips for Landscape & Gardening

This brochure will help you to get the most of your lawn and gardening efforts and keep our waterways clean. Clean waterways provide recreation, establish thriving fish habitats, secure safe sanctuaries for wildlife, and add beauty to our communities. NEVER allow gardening products or waste water to enter the street, gutter or storm drain.

General Landscaping Tips

- Protect stockpiles and materials from wind and rain by storing them under tarps or secured plastic sheeting.
- Prevent erosion of slopes by planting fast-growing, dense ground covering plants. These will shield and bind the soil.

- Plant native vegetation to reduce the amount of water, fertilizers and pesticides applied to the landscape.
- Never apply pesticides or fertilizers when rain is predicted within the next 48 hours.

Garden & Lawn Maintenance

- Do not overwater. Use irrigation practices such as drip irrigation, soaker hoses or micro-spray systems. Periodically inspect and fix leaks and misdirected sprinklers.
- Do not rake or blow leaves, clippings or pruning waste into the street, gutter or storm drain. Instead, dispose of green waste by composting, hauling it to a permitted landfill, or recycling it through your city's program.

- Consider recycling your green waste and adding "nature's own fertilizer" to your lawn or garden.
- Read labels and use only as directed. Do not over-apply pesticides or fertilizers. Apply to spots as needed, rather than blanketing an entire area.
- Store pesticides, fertilizers and other chemicals in a dry covered area to prevent exposure that may result in the deterioration of containers and packaging.
- Rinse empty pesticide containers and re-use rinse water as you would use the product. Do not dump rinse water down storm drains or sewers. Dispose of empty containers in the trash.
- When available, use non-toxic alternatives to traditional pesticides, and use pesticides specifically designed to control the pest you are targeting.
- Try natural long-term common sense solutions first. Integrated Pest Management (IPM) can provide landscaping guidance and solutions, such as:
  - **Physical Controls** - Try hand picking, barriers, traps or caulking holes to control weeds and pests.
  - **Biological Controls** - Use predatory insects to control harmful pests.
  - **Chemical Controls** - Check out www.ipm.ucdavis.edu before using chemicals. Remember, all chemicals should be used cautiously and in moderation.
- If fertilizer is spilled, sweep up the spill before irrigating. If the spill is liquid, apply an absorbent material such as cat litter, and then sweep it up and dispose of it in the trash.
- Take unwanted pesticides to a Household Waste Collection Center to be recycled.
- *Dumping toxics into the street, gutter or storm drain is illegal!*

www.bewaterwise.com Great water conservation tips and drought tolerant garden designs.

www.ourwaterourworld.com Learn how to safely manage home and garden pests.

Additional information can also be found on the back of this brochure.

Helpful telephone numbers and links:

Riverside County Stormwater Protection Partners

Flood Control District	(951) 955-1200
County of Riverside	(951) 955-1000
City of Banning	(951) 922-3105
City of Beaumont	(951) 769-8520
City of Calimesa	(909) 795-9801
City of Canyon Lake	(951) 244-2955
Cathedral City	(760) 770-0327
City of Coachella	(760) 398-4978
City of Corona	(951) 736-2447
City of Desert Hot Springs	(760) 329-6411
City of Eastvale	(951) 361-0900
City of Hemet	(951) 765-2300
City of Indian Wells	(760) 346-2489
City of Indio	(760) 391-4000
City of Lake Elsinore	(951) 674-3124
City of La Quinta	(760) 777-7000
City of Menifee	(951) 672-6777
City of Moreno Valley	(951) 413-3000
City of Murrieta	(951) 304-2489
City of Norco	(951) 270-5607
City of Palm Desert	(760) 346-0611
City of Palm Springs	(760) 323-8299
City of Perris	(951) 943-6100
City of Rancho Mirage	(760) 324-4511
City of Riverside	(951) 361-0900
City of San Jacinto	(951) 654-7337
City of Temecula	(951) 694-6444
City of Wildomar	(951) 677-7751

REPORT ILLEGAL STORM DRAIN DISPOSAL
1-800-506-2555 or e-mail us at
fcnpdes@rcflood.org

- Riverside County Flood Control and Water Conservation District
  www.rcflood.org

Online resources include:

- California Storm Water Quality Association
  www.casqa.org
- State Water Resources Control Board
  www.waterboards.ca.gov
- Power Washers of North America
  www.thepwna.org

Stormwater Pollution

What you should know for...

Outdoor Cleaning Activities and Professional Mobile Service Providers

Storm drain pollution prevention information for:

- Car Washing / Mobile Detailers
- Window and Carpet Cleaners
- Power Washers
- Waterproofers / Street Sweepers
- Equipment cleaners or degreasers and all mobile service providers

Do you know where street flows actually go?

Storm drains are NOT connected to sanitary sewer systems and treatment plants!

The primary purpose of storm drains is to carry *rain* water away from developed areas to prevent flooding. Pollutants discharged to storm drains are transported directly into rivers, lakes and streams. Soaps, degreasers, automotive fluids, litter and a host of materials are washed off buildings, sidewalks, plazas and parking areas. Vehicles and equipment must be properly managed to prevent the pollution of local waterways.

Unintentional spills by mobile service operators can flow into storm drains and pollute our waterways. **Avoid mishaps.** *Always* have a **Spill Response Kit** on hand to clean up unintentional spills. Only emergency **Mechanical** repairs should be done in City streets, using drip pans for spills. **Plumbing** should be done on private property. Always store chemicals in a leak-proof container and keep covered when not in use. **Window/Power Washing** waste water shouldn't be released into the streets, but should be disposed of in a sanitary sewer, landscaped area or in the soil. Soiled **Carpet Cleaning** wash water should be filtered before being discharged into the sanitary sewer. Dispose of all filter debris properly. **Car Washing/Detailing** operators should wash cars on private property and use a regulated hose nozzle for water flow control and runoff prevention. Capture and dispose of waste water and chemicals properly. Remember, storm drains are for receiving rain water runoff only.

REPORT ILLEGAL STORM DRAIN DISPOSAL
1-800-506-2555

Help Protect Our Waterways!

Use these guidelines for Outdoor Cleaning Activities and Wash Water Disposal

Did you know that disposing of pollutants into the street, gutter, storm drain or body of water is *PROHIBITED* by law and can result in stiff penalties?

Best Management Practices

Waste wash water from Mechanics, Plumbers, Window/Power Washers, Carpet Cleaners, Car Washing and Mobile Detailing activities may contain significant quantities of motor oil, grease, chemicals, dirt, detergents, brake pad dust, litter and other materials.

Best Management Practices, or BMPs as they are known, are guides to prevent pollutants from entering the storm drains. ***Each of us*** can do our part to keep stormwater clean by using the suggested BMPs below:

Simple solutions for both light and heavy duty jobs:

Do...consider dry cleaning methods first such as a mop, broom, rag or wire brush. Always keep a spill response kit on site.

Do...prepare the work area before power cleaning by using sand bags, rubber mats, vacuum booms, containment pads or temporary berms to keep wash water away from the gutters and storm drains.

Do...use vacuums or other machines to remove and collect loose debris or litter before applying water.

Do...obtain the property owner's permission to dispose of ***small amounts*** of power washing waste water on to landscaped, gravel or unpaved surfaces.

Do...check your local sanitary sewer agency's policies on wash water disposal regulations before disposing of wash water into the sewer. (See list on reverse side)

Do...be aware that if discharging to landscape areas, soapy wash water may damage landscaping. Residual wash water may remain on paved surfaces to evaporate. Sweep up solid residuals and dispose of properly. Vacuum booms are another option for capturing and collecting wash water.

Do...check to see if local ordinances prevent certain activities.

Do not let...wash or waste water from sidewalk, plaza or building cleaning go into a street or storm drain.

Report illegal storm drain disposal
Call Toll Free
1-800-506-2555

Using Cleaning Agents

Try using biodegradable/phosphate-free products. They are easier on the environment, but don't confuse them with being toxic free. Soapy water entering the storm drain system can impact the delicate aquatic environment.

When cleaning surfaces with a ***high-pressure washer*** or ***steam cleaner***, additional precautions should be taken to prevent the discharge of pollutants into the storm drain system. These two methods of surface cleaning can loosen additional material that can contaminate local waterways.

Think Water Conservation

Minimize water use by using high pressure, low volume nozzles. Be sure to check all hoses for leaks. Water is a precious resource, don't let it flow freely and be sure to shut it off in between uses.

Screening Wash Water

Conduct thorough dry cleanup before washing exterior surfaces, such as buildings and decks ***with loose paint***, sidewalks or plaza areas. Keep debris from entering the storm drain after cleaning by first passing the wash water through a "20 mesh" or finer screen to catch the solid materials, then dispose of the mesh in a refuse container. Do not let the remaining wash water enter a street, gutter or storm drain.

Drain Inlet Protection & Collection of Wash Water

- Prior to any washing, block all storm drains with an impervious barrier such as sandbags or berms, or seal the storm drain with plugs or other appropriate materials.
- Create a containment area with berms and traps or take advantage of a low spot to keep wash water contained.
- Wash vehicles and equipment on grassy or gravel areas so that the wash water can seep into the ground.
- Pump or vacuum up all wash water in the contained area.

Concrete/Coring/Saw Cutting and Drilling Projects

Protect any down-gradient inlets by using dry activity techniques whenever possible. If water is used, minimize the amount of water used during the coring/drilling or saw cutting process. Place a barrier of sandbags and/or absorbent berms to protect the storm drain inlet or watercourse. Use a shovel or wet vacuum to remove the residue from the pavement. Do not wash residue or particulate matter into a storm drain inlet or watercourse.

Non-Stormwater Discharges SC-10

Art Credit: Margie Winter

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	
Nutrients	✓
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	✓
Organics	✓

Description

Non-stormwater discharges are those flows that do not consist entirely of stormwater. Some non-stormwater discharges do not include pollutants and may be discharged to the storm drain. These include uncontaminated groundwater and natural springs. There are also some non-stormwater discharges that typically do not contain pollutants and may be discharged to the storm drain with conditions. These include car washing, air conditioner condensate, etc. However there are certain non-stormwater discharges that pose environmental concern. These discharges may originate from illegal dumping or from internal floor drains, appliances, industrial processes, sinks, and toilets that are connected to the nearby storm drainage system. These discharges (which may include: process waste waters, cooling waters, wash waters, and sanitary wastewater) can carry substances such as paint, oil, fuel and other automotive fluids, chemicals and other pollutants into storm drains. They can generally be detected through a combination of detection and elimination. The ultimate goal is to effectively eliminate non-stormwater discharges to the stormwater drainage system through implementation of measures to detect, correct, and enforce against illicit connections and illegal discharges of pollutants on streets and into the storm drain system and creeks.

Approach

Initially the industry must make an assessment of non-stormwater discharges to determine which types must be eliminated or addressed through BMPs. The focus of the following approach is in the elimination of non-stormwater discharges.

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Pollution Prevention

- Ensure that used oil, used antifreeze, and hazardous chemical recycling programs are being implemented. Encourage litter control.

Suggested Protocols

Recommended Complaint Investigation Equipment

- Field Screening Analysis
  - pH paper or meter
  - Commercial stormwater pollutant screening kit that can detect for reactive phosphorus, nitrate nitrogen, ammonium nitrogen, specific conductance, and turbidity
  - Sample jars
  - Sample collection pole
  - A tool to remove access hole covers
- Laboratory Analysis
  - Sample cooler
  - Ice
  - Sample jars and labels
  - Chain of custody forms
- Documentation
  - Camera
  - Notebook
  - Pens
  - Notice of Violation forms
  - Educational materials

General

- Develop clear protocols and lines of communication for effectively prohibiting non-stormwater discharges, especially those that are not classified as hazardous. These are often not responded to as effectively as they need to be.
- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as “Dump No Waste Drains to Stream” stenciled or demarcated next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.

- See SC44 Stormwater Drainage System Maintenance for additional information.

Illicit Connections

- Locate discharges from the industrial storm drainage system to the municipal storm drain system through review of "as-built" piping schematics.
- Isolate problem areas and plug illicit discharge points.
- Locate and evaluate all discharges to the industrial storm drain system.

Visual Inspection and Inventory

- Inventory and inspect each discharge point during dry weather.
- Keep in mind that drainage from a storm event can continue for a day or two following the end of a storm and groundwater may infiltrate the underground stormwater collection system. Also, non-stormwater discharges are often intermittent and may require periodic inspections.

Review Infield Piping

- A review of the "as-built" piping schematic is a way to determine if there are any connections to the stormwater collection system.
- Inspect the path of floor drains in older buildings.

Smoke Testing

- Smoke testing of wastewater and stormwater collection systems is used to detect connections between the two systems.
- During dry weather the stormwater collection system is filled with smoke and then traced to sources. The appearance of smoke at the base of a toilet indicates that there may be a connection between the sanitary and the stormwater system.

Dye Testing

- A dye test can be performed by simply releasing a dye into either your sanitary or process wastewater system and examining the discharge points from the stormwater collection system for discoloration.

TV Inspection of Drainage System

- TV Cameras can be employed to visually identify illicit connections to the industrial storm drainage system.

Illegal Dumping

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- On paved surfaces, clean up spills with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste.

- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
- For larger spills, a private spill cleanup company or Hazmat team may be necessary.

Once a site has been cleaned:

- Post "No Dumping" signs with a phone number for reporting dumping and disposal.
- Landscaping and beautification efforts of hot spots may also discourage future dumping, as well as provide open space and increase property values.
- Lighting or barriers may also be needed to discourage future dumping.
- See fact sheet SC11 Spill Prevention, Control, and Cleanup.

Inspection

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Conduct field investigations of the industrial storm drain system for potential sources of non-stormwater discharges.
- Pro-actively conduct investigations of high priority areas. Based on historical data, prioritize specific geographic areas and/or incident type for pro-active investigations.

Reporting

- A database is useful for defining and tracking the magnitude and location of the problem.
- Report prohibited non-stormwater discharges observed during the course of normal daily activities so they can be investigated, contained, and cleaned up or eliminated.
- Document that non-stormwater discharges have been eliminated by recording tests performed, methods used, dates of testing, and any on-site drainage points observed.
- Document and report annually the results of the program.
- Maintain documentation of illicit connection and illegal dumping incidents, including significant conditionally exempt discharges that are not properly managed.

Training

- Training of technical staff in identifying and documenting illegal dumping incidents is required.
- Consider posting the quick reference table near storm drains to reinforce training.
- Train employees to identify non-stormwater discharges and report discharges to the appropriate departments.

- Educate employees about spill prevention and cleanup.
- Well-trained employees can reduce human errors that lead to accidental releases or spills. The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur. Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.
- Determine and implement appropriate outreach efforts to reduce non-permissible non-stormwater discharges.
- Conduct spill response drills annually (if no events occurred to evaluate your plan) in cooperation with other industries.
- When a responsible party is identified, educate the party on the impacts of his or her actions.

Spill Response and Prevention

- See SC11 Spill Prevention Control and Cleanup.

Other Considerations

- Many facilities do not have accurate, up-to-date schematic drawings.

Requirements

Costs (including capital and operation & maintenance)

- The primary cost is for staff time and depends on how aggressively a program is implemented.
- Cost for containment and disposal is borne by the discharger.
- Illicit connections can be difficult to locate especially if there is groundwater infiltration.
- Indoor floor drains may require re-plumbing if cross-connections to storm drains are detected.

Maintenance (including administrative and staffing)

- Illegal dumping and illicit connection violations requires technical staff to detect and investigate them.

Supplemental Information

Further Detail of the BMP

Illegal Dumping

- Substances illegally dumped on streets and into the storm drain systems and creeks include paints, used oil and other automotive fluids, construction debris, chemicals, fresh concrete, leaves, grass clippings, and pet wastes. All of these wastes cause stormwater and receiving water quality problems as well as clog the storm drain system itself.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots

- Types and quantities (in some cases) of wastes
- Patterns in time of occurrence (time of day/night, month, or year)
- Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
- Responsible parties

One of the keys to success of reducing or eliminating illegal dumping is increasing the number of people at the facility who are aware of the problem and who have the tools to at least identify the incident, if not correct it. Therefore, train field staff to recognize and report the incidents.

What constitutes a "non-stormwater" discharge?

- Non-stormwater discharges to the stormwater collection system may include any water used directly in the manufacturing process (process wastewater), air conditioning condensate and coolant, non-contact cooling water, cooling equipment condensate, outdoor secondary containment water, vehicle and equipment wash water, sink and drinking fountain wastewater, sanitary wastes, or other wastewaters.

Permit Requirements

- Facilities subject to stormwater permit requirements must include a certification that the stormwater collection system has been tested or evaluated for the presence of non-stormwater discharges. The State's General Industrial Stormwater Permit requires that non-stormwater discharges be eliminated prior to implementation of the facility's SWPPP.

Performance Evaluation

- Review annually internal investigation results; assess whether goals were met and what changes or improvements are necessary.
- Obtain feedback from personnel assigned to respond to, or inspect for, illicit connections and illegal dumping incidents.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Spill Prevention, Control & Cleanup SC-11

Photo Credit: Geoff Brosseau

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	
Nutrients	
Trash	
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Description

Many activities that occur at an industrial or commercial site have the potential to cause accidental or illegal spills. Preparation for accidental or illegal spills, with proper training and reporting systems implemented, can minimize the discharge of pollutants to the environment.

Spills and leaks are one of the largest contributors of stormwater pollutants. Spill prevention and control plans are applicable to any site at which hazardous materials are stored or used. An effective plan should have spill prevention and response procedures that identify potential spill areas, specify material handling procedures, describe spill response procedures, and provide spill clean-up equipment. The plan should take steps to identify and characterize potential spills, eliminate and reduce spill potential, respond to spills when they occur in an effort to prevent pollutants from entering the stormwater drainage system, and train personnel to prevent and control future spills.

Approach

Pollution Prevention

- Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.

- Develop a Spill Prevention Control and Countermeasure (SPCC) Plan. The plan should include:

- Description of the facility, owner and address, activities and chemicals present
- Facility map
- Notification and evacuation procedures
- Cleanup instructions
- Identification of responsible departments
- Identify key spill response personnel

- Recycle, reclaim, or reuse materials whenever possible. This will reduce the amount of process materials that are brought into the facility.

Suggested Protocols (including equipment needs)

Spill Prevention

- Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.

- If consistent illegal dumping is observed at the facility:
  - Post "No Dumping" signs with a phone number for reporting illegal dumping and disposal. Signs should also indicate fines and penalties applicable for illegal dumping.
  - Landscaping and beautification efforts may also discourage illegal dumping.
  - Bright lighting and/or entrance barriers may also be needed to discourage illegal dumping.

- Store and contain liquid materials in such a manner that if the tank is ruptured, the contents will not discharge, flow, or be washed into the storm drainage system, surface waters, or groundwater.

- If the liquid is oil, gas, or other material that separates from and floats on water, install a spill control device (such as a tee section) in the catch basins that collects runoff from the storage tank area.

- Routine maintenance:
  - Place drip pans or absorbent materials beneath all mounted taps, and at all potential drip and spill locations during filling and unloading of tanks. Any collected liquids or soiled absorbent materials must be reused/recycled or properly disposed.
  - Store and maintain appropriate spill cleanup materials in a location known to all near the tank storage area; and ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures.
  - Sweep and clean the storage area monthly if it is paved, *do not hose down the area to a storm drain.*

  - Check tanks (and any containment sumps) daily for leaks and spills. Replace tanks that are leaking, corroded, or otherwise deteriorating with tanks in good condition. Collect all spilled liquids and properly dispose of them.

- Label all containers according to their contents (e.g., solvent, gasoline).
- Label hazardous substances regarding the potential hazard (corrosive, radioactive, flammable, explosive, poisonous).
- Prominently display required labels on transported hazardous and toxic materials (per US DOT regulations).
- Identify key spill response personnel.

Spill Control and Cleanup Activities

- Follow the Spill Prevention Control and Countermeasure Plan.
- Clean up leaks and spills immediately.
- Place a stockpile of spill cleanup materials where it will be readily accessible (e.g., near storage and maintenance areas).
- On paved surfaces, clean up spills with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste. Physical methods for the cleanup of dry chemicals include the use of brooms, shovels, sweepers, or plows.
- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- Chemical cleanups of material can be achieved with the use of adsorbents, gels, and foams. Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
- For larger spills, a private spill cleanup company or Hazmat team may be necessary.

Reporting

- Report spills that pose an immediate threat to human health or the environment to the Regional Water Quality Control Board.
- Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hour).
- Report spills to local agencies, such as the fire department; they can assist in cleanup.
- Establish a system for tracking incidents. The system should be designed to identify the following:

  - Types and quantities (in some cases) of wastes

  - Patterns in time of occurrence (time of day/night, month, or year)

- Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)

- Responsible parties

Training

- Educate employees about spill prevention and cleanup.

- Well-trained employees can reduce human errors that lead to accidental releases or spills:

  - The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.

  - Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.

- Employees should be educated about aboveground storage tank requirements. Employees responsible for aboveground storage tanks and liquid transfers should be thoroughly familiar with the Spill Prevention Control and Countermeasure Plan and the plan should be readily available.

- Train employees to recognize and report illegal dumping incidents.

Other Considerations (Limitations and Regulations)

- A Spill Prevention Control and Countermeasure Plan (SPCC) is required for facilities that are subject to the oil pollution regulations specified in Part 112 of Title 40 of the Code of Federal Regulations or if they have a storage capacity of 10,000 gallons or more of petroleum. (Health and Safety Code 6.67)

- State regulations also exist for storage of hazardous materials (Health & Safety Code Chapter 6.95), including the preparation of area and business plans for emergency response to the releases or threatened releases.

- Consider requiring smaller secondary containment areas (less than 200 sq. ft.) to be connected to the sanitary sewer, prohibiting any hard connections to the storm drain.

Requirements

Costs (including capital and operation & maintenance)

- Will vary depending on the size of the facility and the necessary controls.

- Prevention of leaks and spills is inexpensive. Treatment and/or disposal of contaminated soil or water can be quite expensive.

Maintenance (including administrative and staffing)

- This BMP has no major administrative or staffing requirements. However, extra time is needed to properly handle and dispose of spills, which results in increased labor costs.

Supplemental Information

Further Detail of the BMP

Reporting

Record keeping and internal reporting represent good operating practices because they can increase the efficiency of the facility and the effectiveness of BMPs. A good record keeping system helps the facility minimize incident recurrence, correctly respond with appropriate cleanup activities, and comply with legal requirements. A record keeping and reporting system should be set up for documenting spills, leaks, and other discharges, including discharges of hazardous substances in reportable quantities. Incident records describe the quality and quantity of non-stormwater discharges to the storm sewer. These records should contain the following information:

- Date and time of the incident
- Weather conditions
- Duration of the spill/leak/discharge
- Cause of the spill/leak/discharge
- Response procedures implemented
- Persons notified
- Environmental problems associated with the spill/leak/discharge

Separate record keeping systems should be established to document housekeeping and preventive maintenance inspections, and training activities. All housekeeping and preventive maintenance inspections should be documented. Inspection documentation should contain the following information:

- The date and time the inspection was performed
- Name of the inspector
- Items inspected
- Problems noted
- Corrective action required
- Date corrective action was taken

Other means to document and record inspection results are field notes, timed and dated photographs, videotapes, and drawings and maps.

Aboveground Tank Leak and Spill Control

Accidental releases of materials from aboveground liquid storage tanks present the potential for contaminating stormwater with many different pollutants. Materials spilled, leaked, or lost from

tanks may accumulate in soils or on impervious surfaces and be carried away by stormwater runoff.

The most common causes of unintentional releases are:

- Installation problems
- Failure of piping systems (pipes, pumps, flanges, couplings, hoses, and valves)
- External corrosion and structural failure
- Spills and overfills due to operator error
- Leaks during pumping of liquids or gases from truck or rail car to a storage tank or vice versa

Storage of reactive, ignitable, or flammable liquids should comply with the Uniform Fire Code and the National Electric Code. Practices listed below should be employed to enhance the code requirements:

- Tanks should be placed in a designated area.
- Tanks located in areas where firearms are discharged should be encapsulated in concrete or the equivalent.
- Designated areas should be impervious and paved with Portland cement concrete, free of cracks and gaps, in order to contain leaks and spills.
- Liquid materials should be stored in UL approved double walled tanks or surrounded by a curb or dike to provide the volume to contain 10 percent of the volume of all of the containers or 110 percent of the volume of the largest container, whichever is greater. The area inside the curb should slope to a drain.
- For used oil or dangerous waste, a dead-end sump should be installed in the drain.
- All other liquids should be drained to the sanitary sewer if available. The drain must have a positive control such as a lock, valve, or plug to prevent release of contaminated liquids.
- Accumulated stormwater in petroleum storage areas should be passed through an oil/water separator.

Maintenance is critical to preventing leaks and spills. Conduct routine inspections and:

- Check for external corrosion and structural failure.
- Check for spills and overfills due to operator error.
- Check for failure of piping system (pipes, pumps, flanger, coupling, hoses, and valves).
- Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or vice versa.

- Visually inspect new tank or container installation for loose fittings, poor welding, and improper or poorly fitted gaskets.
- Inspect tank foundations, connections, coatings, and tank walls and piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.
- Frequently relocate accumulated stormwater during the wet season.
- Periodically conduct integrity testing by a qualified professional.

Vehicle Leak and Spill Control

Major spills on roadways and other public areas are generally handled by highly trained Hazmat teams from local fire departments or environmental health departments. The measures listed below pertain to leaks and smaller spills at vehicle maintenance shops.

In addition to implementing the spill prevention, control, and clean up practices above, use the following measures related to specific activities:

Vehicle and Equipment Maintenance

- Perform all vehicle fluid removal or changing inside or under cover to prevent the run-on of stormwater and the runoff of spills.
- Regularly inspect vehicles and equipment for leaks, and repair immediately.
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment onsite.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Immediately drain all fluids from wrecked vehicles.
- Store wrecked vehicles or damaged equipment under cover.
- Place drip pans or absorbent materials under heavy equipment when not in use.
- Use adsorbent materials on small spills rather than hosing down the spill.
- Remove the adsorbent materials promptly and dispose of properly.
- Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.
- Oil filters disposed of in trashcans or dumpsters can leak oil and contaminate stormwater. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.

- Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries, even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Vehicle and Equipment Fueling

- Design the fueling area to prevent the run-on of stormwater and the runoff of spills:
  - Cover fueling area if possible.
  - Use a perimeter drain or slope pavement inward with drainage to a sump.
  - Pave fueling area with concrete rather than asphalt.
- If dead-end sump is not used to collect spills, install an oil/water separator.
- Install vapor recovery nozzles to help control drips as well as air pollution.
- Discourage "topping-off' of fuel tanks.
- Use secondary containment when transferring fuel from the tank truck to the fuel tank.
- Use adsorbent materials on small spills and general cleaning rather than hosing down the area. Remove the adsorbent materials promptly.
- Carry out all Federal and State requirements regarding underground storage tanks, or install above ground tanks.
- Do not use mobile fueling of mobile industrial equipment around the facility; rather, transport the equipment to designated fueling areas.
- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Train employees in proper fueling and cleanup procedures.

Industrial Spill Prevention Response

For the purposes of developing a spill prevention and response program to meet the stormwater regulations, facility managers should use information provided in this fact sheet and the spill prevention/response portions of the fact sheets in this handbook, for specific activities. The program should:

- Integrate with existing emergency response/hazardous materials programs (e.g., Fire Department)
- Develop procedures to prevent/mitigate spills to storm drain systems
- Identify responsible departments
- Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures
- Address spills at municipal facilities, as well as public areas

- Provide training concerning spill prevention, response and cleanup to all appropriate personnel

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Stormwater Managers Resource Center http://www.stormwatercenter.net/

Waste Handling & Disposal SC-34

Photo Credit: Geoff Brosseau

Description

Improper storage and handling of solid wastes can allow toxic compounds, oils and greases, heavy metals, nutrients, suspended solids, and other pollutants to enter stormwater runoff. The discharge of pollutants to stormwater from waste handling and disposal can be prevented and reduced by tracking waste generation, storage, and disposal; reducing waste generation and disposal through source reduction, reuse, and recycling; and preventing run-on and runoff.

Approach

Pollution Prevention

- Accomplish reduction in the amount of waste generated using the following source controls:
  - Production planning and sequencing
  - Process or equipment modification
  - Raw material substitution or elimination
  - Loss prevention and housekeeping
  - Waste segregation and separation
  - Close loop recycling
- Establish a material tracking system to increase awareness about material usage. This may reduce spills and minimize contamination, thus reducing the amount of waste produced.
- Recycle materials whenever possible.

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	
Nutrients	
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	✓
Organics	✓

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Suggested Protocols

General

- Cover storage containers with leak proof lids or some other means. If waste is not in containers, cover all waste piles (plastic tarps are acceptable coverage) and prevent stormwater run-on and runoff with a berm. The waste containers or piles must be covered except when in use.
- Use drip pans or absorbent materials whenever grease containers are emptied by vacuum trucks or other means. Grease cannot be left on the ground. Collected grease must be properly disposed of as garbage.
- Check storage containers weekly for leaks and to ensure that lids are on tightly. Replace any that are leaking, corroded, or otherwise deteriorating.
- Sweep and clean the storage area regularly. If it is paved, do not hose down the area to a storm drain.
- Dispose of rinse and wash water from cleaning waste containers into a sanitary sewer if allowed by the local sewer authority. Do not discharge wash water to the street or storm drain.
- Transfer waste from damaged containers into safe containers.
- Take special care when loading or unloading wastes to minimize losses. Loading systems can be used to minimize spills and fugitive emission losses such as dust or mist. Vacuum transfer systems can minimize waste loss.

Controlling Litter

- Post "No Littering" signs and enforce anti-litter laws.
- Provide a sufficient number of litter receptacles for the facility.
- Clean out and cover litter receptacles frequently to prevent spillage.

Waste Collection

- Keep waste collection areas clean.
- Inspect solid waste containers for structural damage regularly. Repair or replace damaged containers as necessary.
- Secure solid waste containers; containers must be closed tightly when not in use.
- Do not fill waste containers with washout water or any other liquid.
- Ensure that only appropriate solid wastes are added to the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, pesticides, etc., may not be disposed of in solid waste containers (see chemical/ hazardous waste collection section below).

- Do not mix wastes; this can cause chemical reactions, make recycling impossible, and complicate disposal.

Good Housekeeping

- Use all of the product before disposing of the container.
- Keep the waste management area clean at all times by sweeping and cleaning up spills immediately.
- Use dry methods when possible (e.g., sweeping, use of absorbents) when cleaning around restaurant/food handling dumpster areas. If water must be used after sweeping/using absorbents, collect water and discharge through grease interceptor to the sewer.

Chemical/Hazardous Wastes

- Select designated hazardous waste collection areas on-site.
- Store hazardous materials and wastes in covered containers and protect them from vandalism.
- Place hazardous waste containers in secondary containment.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.
- Stencil or demarcate storm drains on the facility's property with prohibitive message regarding waste disposal.

Run-on/Runoff Prevention

- Prevent stormwater run-on from entering the waste management area by enclosing the area or building a berm around the area.
- Prevent waste materials from directly contacting rain.
- Cover waste piles with temporary covering material such as reinforced tarpaulin, polyethylene, polyurethane, polypropyleneor hypalon.
- Cover the area with a permanent roof if feasible.
- Cover dumpsters to prevent rain from washing waste out of holes or cracks in the bottom of the dumpster.
- Move the activity indoor after ensuring all safety concerns such as fire hazard and ventilation are addressed.

Inspection

- Inspect and replace faulty pumps or hoses regularly to minimize the potential of releases and spills.
- Check waste management areas for leaking containers or spills.

- Repair leaking equipment including valves, lines, seals, or pumps promptly.

Training

- Train staff in pollution prevention measures and proper disposal methods.
- Train employees and contractors in proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.
- Train employees and subcontractors in proper hazardous waste management.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Have an emergency plan, equipment and trained personnel ready at all times to deal immediately with major spills
- Collect all spilled liquids and properly dispose of them.
- Store and maintain appropriate spill cleanup materials in a location known to all near the designated wash area.
- Ensure that vehicles transporting waste have spill prevention equipment that can prevent spills during transport. Spill prevention equipment includes:
  - Vehicles equipped with baffles for liquid waste
  - Trucks with sealed gates and spill guards for solid waste

Other Considerations (Limitations and Regulations)

Hazardous waste cannot be reused or recycled; it must be disposed of by a licensed hazardous waste hauler.

Requirements

Costs

Capital and O&M costs for these programs will vary substantially depending on the size of the facility and the types of waste handled. Costs should be low if there is an inventory program in place.

Maintenance

- None except for maintaining equipment for material tracking program.

Supplemental Information

Further Detail of the BMP

Land Treatment System

Minimize runoff of polluted stormwater from land application by:

- Choosing a site where slopes are under 6%, the soil is permeable, there is a low water table, it is located away from wetlands or marshes, and there is a closed drainage system

- Avoiding application of waste to the site when it is raining or when the ground is saturated with water
- Growing vegetation on land disposal areas to stabilize soils and reduce the volume of surface water runoff from the site
- Maintaining adequate barriers between the land application site and the receiving waters (planted strips are particularly good)
- Using erosion control techniques such as mulching and matting, filter fences, straw bales, diversion terracing, and sediment basins
- Performing routine maintenance to ensure the erosion control or site stabilization measures are working

Examples

The port of Long Beach has a state-of-the-art database for identifying potential pollutant sources, documenting facility management practices, and tracking pollutants.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

Solid Waste Container Best Management Practices – Fact Sheet On-Line Resources – Environmental Health and Safety. Harvard University. 2002.

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Building & Grounds Maintenance SC-41

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	
Organics	

Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, abnormal pH, and oils and greases. Utilizing the protocols in this fact sheet will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Encourage proper lawn management and landscaping, including use of native vegetation.

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- Encourage use of Integrated Pest Management techniques for pest control.
- Encourage proper onsite recycling of yard trimmings.
- Recycle residual paints, solvents, lumber, and other material as much as possible.

Suggested Protocols

Pressure Washing of Buildings, Rooftops, and Other Large Objects

- In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.
- If soaps or detergents are not used, and the surrounding area is paved, wash runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in the catch basin to trap the particles in wash water runoff.
- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement.

Landscaping Activities

- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures on exposed soils.

Building Repair, Remodeling, and Construction

- Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.
- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.
- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.
- Clean paintbrushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.
- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. This is particularly necessary on rainy days. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and solids must be collected and disposed of before removing the containment device(s) at the end of the work day.

- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. If directed off-site, you should direct the water through hay bales and filter fabric or use other sediment filters or traps.
- Store toxic material under cover during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

Mowing, Trimming, and Planting

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures when soils are exposed.
- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Consider an alternative approach when bailing out muddy water: do not put it in the storm drain; pour over landscaped areas.
- Use hand weeding where practical.

Fertilizer and Pesticide Management

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.
- Use less toxic pesticides that will do the job when applicable. Avoid use of copper-based pesticides if possible.
- Do not use pesticides if rain is expected.
- Do not mix or prepare pesticides for application near storm drains.
- Use the minimum amount needed for the job.
- Calibrate fertilizer distributors to avoid excessive application.
- Employ techniques to minimize off-target application (e.g., spray drift) of pesticides, including consideration of alternative application techniques.
- Apply pesticides only when wind speeds are low.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Irrigate slowly to prevent runoff and then only as much as is needed.
- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Dispose of empty pesticide containers according to the instructions on the container label.

- Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering and repair leaks in the irrigation system as soon as they are observed.

Training

- Educate and train employees on pesticide use and in pesticide application techniques to prevent pollution.
- Train employees and contractors in proper techniques for spill containment and cleanup.
- Be sure the frequency of training takes into account the complexity of the operations and the nature of the staff.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials, such as brooms, dustpans, and vacuum sweepers (if desired) near the storage area where it will be readily accessible.
- Have employees trained in spill containment and cleanup present during the loading/unloading of dangerous wastes, liquid chemicals, or other materials.
- Familiarize employees with the Spill Prevention Control and Countermeasure Plan.
- Clean up spills immediately.

Other Considerations

Alternative pest/weed controls may not be available, suitable, or effective in many cases.

Requirements

Costs

- Cost will vary depending on the type and size of facility.
- Overall costs should be low in comparison to other BMPs.

Maintenance

Sweep paved areas regularly to collect loose particles. Wipe up spills with rags and other absorbent material immediately, do not hose down the area to a storm drain.

Supplemental Information

Further Detail of the BMP

Fire Sprinkler Line Flushing

Building fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water, though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping, but it is subject to rusting and results in lower quality water. Initially, the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, poly-phosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time (typically a year) and between flushes may accumulate iron, manganese, lead, copper, nickel, and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Drainage System Maintenance SC-44

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff and stormwater that may contain certain pollutants. The protocols in this fact sheet are intended to reduce pollutants reaching receiving waters through proper conveyance system operation and maintenance.

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	
Bacteria	✓
Oil and Grease	
Organics	

Approach

Pollution Prevention

Maintain catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

Suggested Protocols

Catch Basins/Inlet Structures

- Staff should regularly inspect facilities to ensure compliance with the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC34 Waste Handling and Disposal).

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- Clean catch basins, storm drain inlets, and other conveyance structures before the wet season to remove sediments and debris accumulated during the summer.
- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes if necessary with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed. Do not dewater near a storm drain or stream.

Storm Drain Conveyance System

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect and pump flushed effluent to the sanitary sewer for treatment whenever possible.

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge to reach the storm drain system when cleaning a storm drain pump station or other facility.
- Conduct routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.

Open Channel

- Modify storm channel characteristics to improve channel hydraulics, increase pollutant removals, and enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a Steam or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies (SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS.

Illicit Connections and Discharges

- Look for evidence of illegal discharges or illicit connections during routine maintenance of conveyance system and drainage structures:
  - Is there evidence of spills such as paints, discoloring, etc?

- Are there any odors associated with the drainage system?
- Record locations of apparent illegal discharges/illicit connections?
- Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of upgradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
- Eliminate the discharge once the origin of flow is established.

- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Illegal Dumping

- Inspect and clean up hot spots and other storm drainage areas regularly where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties
- Post "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.
- Allow only properly trained individuals to handle hazardous materials/wastes.
- Have staff involved in detection and removal of illicit connections trained in the following:
  - OSHA-required Health and Safety Training (29 CFR 1910.120) plus annual refresher training (as needed).

- OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and Federal OSHA 29 CFR 1910.146).

- Procedural training (field screening, sampling, smoke/dye testing, TV inspection).

Spill Response and Prevention

- Investigate all reports of spills, leaks, and/or illegal dumping promptly.
- Clean up all spills and leaks using "dry" methods (with absorbent materials and/or rags) or dig up, remove, and properly dispose of contaminated soil.
- Refer to fact sheet SC-11 Spill Prevention, Control, and Cleanup.

Other Considerations (Limitations and Regulations)

- Clean-up activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.
- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and prohibition against disposal of flushed effluent to sanitary sewer in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Local municipal codes may include sections prohibiting discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.

Requirements

Costs

- An aggressive catch basin cleaning program could require a significant capital and O&M budget.
- The elimination of illegal dumping is dependent on the availability, convenience, and cost of alternative means of disposal. The primary cost is for staff time. Cost depends on how aggressively a program is implemented. Other cost considerations for an illegal dumping program include:

  - Purchase and installation of signs.

  - Rental of vehicle(s) to haul illegally-disposed items and material to landfills.

  - Rental of heavy equipment to remove larger items (e.g., car bodies) from channels.

  - Purchase of landfill space to dispose of illegally-dumped items and material.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary.

Maintenance

- Two-person teams may be required to clean catch basins with vactor trucks.
- Teams of at least two people plus administrative personnel are required to identify illicit discharges, depending on the complexity of the storm sewer system.
- Arrangements must be made for proper disposal of collected wastes.
- Technical staff are required to detect and investigate illegal dumping violations.

Supplemental Information

Further Detail of the BMP

Storm Drain Flushing

Flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in storm drainage systems. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as an open channel, another point where flushing will be initiated, or the sanitary sewer and the treatment facilities, thus preventing resuspension and overflow of a portion of the solids during storm events. Flushing prevents "plug flow" discharges of concentrated pollutant loadings and sediments. Deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, thereby releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce impacts of stormwater pollution, a second inflatable device placed well downstream may be used to recollect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to recollect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75% for organics and 55-65% for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm sewer flushing.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

Ferguson, B.K. 1991. Urban Stream Reclamation, p. 324-322, Journal of Soil and Water Conservation.

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Storm Drain System Cleaning. On line:
http://www.epa.gov/npdes/menuofbmps/poll_16.htm

Site Design & Landscape Planning SD-10

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- ☑ Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.

Designing New Installations

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.
- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Conserve Natural Areas during Landscape Planning

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.
- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.
- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.
- Promote natural vegetation by using parking lot islands and other landscaped areas.
- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.
- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and

regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

Protection of Slopes and Channels during Landscape Design

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of “ redevelopment” must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under “designing new installations” above should be followed.

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Roof Runoff Controls SD-11

Rain Garden

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

Description

Various roof runoff controls are available to address stormwater that drains off rooftops. The objective is to reduce the total volume and rate of runoff from individual lots, and retain the pollutants on site that may be picked up from roofing materials and atmospheric deposition. Roof runoff controls consist of directing the roof runoff away from paved areas and mitigating flow to the storm drain system through one of several general approaches: cisterns or rain barrels; dry wells or infiltration trenches; pop-up emitters, and foundation planting. The first three approaches require the roof runoff to be contained in a gutter and downspout system. Foundation planting provides a vegetated strip under the drip line of the roof.

Approach

Design of individual lots for single-family homes as well as lots for higher density residential and commercial structures should consider site design provisions for containing and infiltrating roof runoff or directing roof runoff to vegetative swales or buffer areas. Retained water can be reused for watering gardens, lawns, and trees. Benefits to the environment include reduced demand for potable water used for irrigation, improved stormwater quality, increased groundwater recharge, decreased runoff volume and peak flows, and decreased flooding potential.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

One method of addressing roof runoff is to direct roof downspouts to cisterns or rain barrels. A cistern is an above ground storage vessel with either a manually operated valve or a permanently open outlet. Roof runoff is temporarily stored and then released for irrigation or infiltration between storms. The number of rain

barrels needed is a function of the rooftop area. Some low impact developers recommend that every house have at least 2 rain barrels, with a minimum storage capacity of 1000 liters. Roof barrels serve several purposes including mitigating the first flush from the roof which has a high volume, amount of contaminants, and thermal load. Several types of rain barrels are commercially available. Consideration must be given to selecting rain barrels that are vector proof and childproof. In addition, some barrels are designed with a bypass valve that filters out grit and other contaminants and routes overflow to a soak-away pit or rain garden.

If the cistern has an operable valve, the valve can be closed to store stormwater for irrigation or infiltration between storms. This system requires continual monitoring by the resident or grounds crews, but provides greater flexibility in water storage and metering. If a cistern is provided with an operable valve and water is stored inside for long periods, the cistern must be covered to prevent mosquitoes from breeding.

A cistern system with a permanently open outlet can also provide for metering stormwater runoff. If the cistern outlet is significantly smaller than the size of the downspout inlet (say ¼ to ½ inch diameter), runoff will build up inside the cistern during storms, and will empty out slowly after peak intensities subside. This is a feasible way to mitigate the peak flow increases caused by rooftop impervious land coverage, especially for the frequent, small storms.

Dry wells and Infiltration Trenches

Roof downspouts can be directed to dry wells or infiltration trenches. A dry well is constructed by excavating a hole in the ground and filling it with an open graded aggregate, and allowing the water to fill the dry well and infiltrate after the storm event. An underground connection from the downspout conveys water into the dry well, allowing it to be stored in the voids. To minimize sedimentation from lateral soil movement, the sides and top of the stone storage matrix can be wrapped in a permeable filter fabric, though the bottom may remain open. A perforated observation pipe can be inserted vertically into the dry well to allow for inspection and maintenance.

In practice, dry wells receiving runoff from single roof downspouts have been successful over long periods because they contain very little sediment. They must be sized according to the amount of rooftop runoff received, but are typically 4 to 5 feet square, and 2 to 3 feet deep, with a minimum of 1-foot soil cover over the top (maximum depth of 10 feet).

To protect the foundation, dry wells must be set away from the building at least 10 feet. They must be installed in solids that accommodate infiltration. In poorly drained soils, dry wells have very limited feasibility.

Infiltration trenches function in a similar manner and would be particularly effective for larger roof areas. An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. These are described under Treatment Controls.

Pop-up Drainage Emitter

Roof downspouts can be directed to an underground pipe that daylights some distance from the building foundation, releasing the roof runoff through a pop-up emitter. Similar to a pop-up irrigation head, the emitter only opens when there is flow from the roof. The emitter remains flush to the ground during dry periods, for ease of lawn or landscape maintenance.

Foundation Planting

Landscape planting can be provided around the base to allow increased opportunities for stormwater infiltration and protect the soil from erosion caused by concentrated sheet flow coming off the roof. Foundation plantings can reduce the physical impact of water on the soil and provide a subsurface matrix of roots that encourage infiltration. These plantings must be sturdy enough to tolerate the heavy runoff sheet flows, and periodic soil saturation.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Supplemental Information

Examples

- City of Ottawa's Water Links Surface –Water Quality Protection Program
- City of Toronto Downspout Disconnection Program
- City of Boston, MA, Rain Barrel Demonstration Program

Other Resources

Hager, Marty Catherine, Stormwater, "Low-Impact Development", January/February 2003. www.stormh2o.com

Low Impact Urban Design Tools, Low Impact Development Design Center, Beltsville, MD. www.lid-stormwater.net

Start at the Source, Bay Area Stormwater Management Agencies Association, 1999 Edition

Efficient Irrigation SD-12

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Designing New Installations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.

- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff
  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect
  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible
  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Storm Drain Signage SD-13

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- ☑ Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

Designing New Installations

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include “NO DUMPING

– DRAINS TO OCEAN" and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of "redevelopment", then the requirements stated under " designing new installations" above should be included in all project design plans.

Additional Information

Maintenance Considerations

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner's association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

Placement

- Signage on top of curbs tends to weather and fade.

- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

Supplemental Information

Examples

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Trash Storage Areas SD-32

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

Description

Trash storage areas are areas where a trash receptacle (s) are located for use as a repository for solid wastes. Stormwater runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. Waste handling operations that may be sources of stormwater pollution include dumpsters, litter control, and waste piles.

Approach

This fact sheet contains details on the specific measures required to prevent or reduce pollutants in stormwater runoff associated with trash storage and handling. Preventative measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Design requirements for waste handling areas are governed by Building and Fire Codes, and by current local agency ordinances and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements. Hazardous waste should be handled in accordance with legal requirements established in Title 22, California Code of Regulation.

Wastes from commercial and industrial sites are typically hauled by either public or commercial carriers that may have design or access requirements for waste storage areas. The design criteria in this fact sheet are recommendations and are not intended to be in conflict with requirements established by the waste hauler. The waste hauler should be contacted prior to the design of your site trash collection areas. Conflicts or issues should be discussed with the local agency.

Designing New Installations

Trash storage areas should be designed to consider the following structural or treatment control BMPs:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of stormwater.
- Make sure trash container areas are screened or walled to prevent off-site transport of trash.

- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Additional Information

Maintenance Considerations

The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Maintenance agreements between the local agency and the owner/operator may be required. Some agencies will require maintenance deed restrictions to be recorded of the property title. If required by the local agency, maintenance agreements or deed restrictions must be executed by the owner/operator before improvement plans are approved.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.